McGRAW-HILL
PUBLISHING COMPANY, INC.
JAMES H. McGRAW, *President*
MASON BRITTON, *Vice-President*

POWER

Editor
FRED R. LOW
Associate Editors
C. H. BERRY
A. D. BLAKE

Volume 67 New York, May 8, 1928 *Number 19*

Success

IN AN account, which I have just read, of the celebration of the twenty-fifth anniversary of the founding, by Irving T. Bush, of the Bush Terminal, there are two thoughts that stood out prominently in my mind when I had turned the last page.

One was the inscription over the fireplace of the building erected by Mr. Bush for the use and comfort of his longshoremen:

"Success is not an accident. It comes to the man who does his work a little better than the other fellow."

There are plenty of people who do things ordinarily well—well enough so that they are allowed to keep on doing them; well enough to hold their jobs.

But the one who does his work better, succeeds. He succeeds, first of all in doing what he set out to do, or what was set out for him to do, and in doing it masterfully and right. He accomplishes something and finds a pride and pleasure in doing it. If it were not for the interest that fructifies in that satisfaction, he would not do it better.

And then he succeeds because, when somebody is wanted for a better job and larger responsibilities, the executive whose job it is to get things done and done well naturally turns to those who have done other and lesser things better.

And this leads to the second outstanding thought expressed by Mr. Bush in accepting the tribute paid to him by his employees; and that is, that it is no disparagement to one that he works for gain.

A man should work for the love of work and be activated by a real interest in it, if he is going to do it better than the other fellow.

But this interest will not be embittered and resentful if there is behind it the realization that he is getting a fair share of the product—that he is not working solely in the interest of a sordid employer, but working with a real leader in a service in the success of which they are both materially concerned.

I have no sympathy with the man to whom the pay envelope is the principal thing in the picture, whose thoughts are on what he is going to get rather than upon what he can do.

But the enlightened self-interest of which we have read so much lately has its personal as well as its institutional significance. To quote Mr. Bush again, "An ideal which cannot pay its board and keep usually ends in the poorhouse —It is better for an ideal to end at the Ritz than at the county poor farm."

Initiative, adventure, enterprise, resourcefulness, skillful management are entitled to a generous return. So are interested participation and unselfish devotion on the part of those who work under direction.

Devotion, application and whole-souled interest in one's job, appreciation of what the Big Boss is trying to do and earnest effort in helping him to do it, do not involve the altruistic subserviency of one's personal interest, but a helpful part in carrying out the project of a leader and participation in its success.

Skill Is Not Dead

ONE of the complaints made against this mechanical civilization is that the machine deprives the man of the chance to use his native skill. This is true in some cases, but a look around should convince anyone that skill is not dead and shows no prospect of dying—that it merely passes from one field to another. Automatic production machines reduce the demand for skill on the part of the machine operator. At the same time they call for greater expertness in machine designers, toolmakers, machine setters and foremen. Machines encroach on ancient trades. In come such new arts as welding, calling for skilled hands and alert brains—"supertrades" demanding all the workmanlike virtues of the old-time mechanic.

As machines multiply, the problem of organizing their work, servicing them, insuring continuous supplies of power, steam, water and air, controlling speed, temperature and humidity, create new problems of engineering management. The men who have to face these demands are not worrying about the death of skill from disuse. Their only concern is how to learn fast enough to keep ahead of the production procession.

True, there are more hunkies than formerly in the shop, but there are fewer out in the ditch since the steam shovel got busy there. It is a new show with all the parts and scenery changed, but there are still more stellar rôles than actors who can play them.

Heat and Byproduct Power Need Not Be Balanced

THE idea persists that an exact balance between process steam and byproduct power is necessary for maximum fuel economy in an industrial plant. This is not true.

While in theory a state of exact balance is as good as any, this condition is unattainable. Theoretically, it is just as economical and practically it is much more so to have the plant "out of balance" so that more power than is needed can always be generated from the process steam. The ability to produce excess power involves no loss whatever and acts as insurance against the occurrence of the opposite, and really wasteful, condition where more steam must be used for power than can be absorbed by the process.

The explanation is easy enough, assuming that all steam from prime movers is exhausted to process and none to condensers. With exact balance the heat supplied by the boiler is that required by the process plus the equivalent of about one-third of a pound of coal for each kilowatt-hour produced. Now suppose the demand for process steam increases, while that for power remains the same. The additional process demand must be supplied by live steam. The only way to avoid using live steam would be to increase the steam rate of the prime mover. Avoiding the use of live steam in this way saves exactly nothing. In either case the boiler must supply the process demand plus the coal equivalent of each kilowatt-hour generated.

The thing to be avoided is not live steam going to process, but the waste of heat in visible exhaust or in condenser circulating water and the necessity for bringing in power from the outside. Here are the four real tests of fuel economy in a process plant: First, minimum waste of steam at the processes and in transmission; second, maximum over-all boiler efficiency; third, minimum power brought in from outside; fourth, minimum waste of heat in visible exhaust and circulating water.

In practice, with fluctuating power and process loads, this ideal is most closely approached by using high steam pressures, low back pressures, and efficient engines or turbines to keep the steam rate as low as possible. If some live steam has to be bypassed to process now and then, nothing is lost. The wasteful periods of free exhaust are made less frequent. Incidentally, an excess of byproduct power capacity can often find new productive uses. It is like money in the bank.

Can Industrial Power Costs Be Reduced?

WHERE lies the best opportunity today for the reduction of industrial power costs? Many will say that approximating central station practice as nearly as possible is the best way to make savings. But that is not correct. Savings can be made in that way, but still greater economies lie along other paths.

The greatest rewards in reduced cost of power can be realized from improvements in power application. In industrial plants it is not the cost per kilowatt-hour or per pound of steam that should interest the power engineer most, but rather the cost of power in the finished goods turned out. Power that is cheap at the powerhouse wall becomes expensive if misapplied in the factory. The power engineer can benefit his industry most and gain for himself the greatest credit by reducing the cost of power chargeable against the factory output.

In doing this, the power engineer becomes a salesman with a mission just opposite to that of other salesmen. He must use his every effort to induce the production departments of the plant to use smaller amounts of the power plant's products rather than larger. He must substitute exhaust for live steam, where the former will do the work, and hot water for exhaust steam where that is possible. There are a thousand and one other ways in which the cost of power consumed can be reduced. And the savings thus made will more often than not outweigh any savings that can be made in the power plant itself.

A.W.S. Presidents

F. M. FARMER, chief engineer of the Electrical Testing Laboratories (New York), has retired as president of the American Welding Society after two years of distinguished service. His task has not been easy, for, while the welding industry has been growing by leaps and bounds, the very rapidity of its growth created problems demanding sound judgment and the ability to act promptly and effectively. These qualities Mr. Farmer brought to the job. His efforts have been an essential factor in broadening the influence of the society and in advancing its important research and educational programs.

His two terms have seen a notable change in the attitude toward welding as a method of fabricating pressure vessels and steel structures. The old-time hesitancies are giving way to open acceptance in the pressure-vessel field. Structural welding, which still has many problems

to solve, has already made a good commercial start and is forging ahead with the active co-operation of leading steel fabricators. During Mr. Farmer's term of office welding has made enormous strides in machine fabrication and is now established as one of the most important manufacturing processes. Its use as a tool of maintenance and repair has likewise grown.

Continued sound progress in the basic activities of the society is assured by the election of F. T. Llewellyn as the new president. Mr. Llewellyn, of the United States Steel Corporation, combines engineering knowledge and executive skill to a notable degree. While he is primarily a structural steel man, he has the type of mind that can quickly grasp the essentials of all the tasks that confront the society.

It is a fortunate thing that the American Welding Society is building up in these formative years a tradition of competent leadership. The standards and practices being established now under such guidance will influence the whole course of the welding industry in the greater years to come.

Don't Forget Water Power

MAKING tests, keeping and analyzing records of water-power plants, has been found to be as important as it is in steam plants. Notwithstanding this, little attention is given to this feature in many hydro-electric stations. Even on systems where both steam and water-power plants are operated in parallel, the water-power station's efficiency may be neglected, while in the steam plants the performance is carefully studied. The steam plant will be tested and checked carefully and be equipped with the most modern methods of measuring all quantities affecting the efficiency, yet, as long as the water-power units will carry their load, their efficiency is accepted on faith.

Sufficient experience has been gained in the economic value of tests and operating records in water-power plants to prove conclusively that they can be made to pay handsome dividends on the cost of obtaining them. Where this problem has been gone into carefully, it has been found advantageous to operate hydro-electric plants to obtain the maximum number of kilowatt-hours from the available water. In some cases these plants are equipped with complete measuring devices to give a continuous record of operation, and the proper use of this apparatus is required by the operators. On one system it has been found that the saving in one year, after installing metering equipment, more than paid for its installation.

In high-head plants using impulse wheels, the condition of the nozzles has been found to have a marked effect on the efficiency of the units. In one instance an expenditure of less than two hundred dollars to change the nozzles made a saving of about twelve thousand dollars a year in the increased power output from a given quantity of water.

It is little use saving a ton of coal in a steam station if, by neglecting the water-power plants, a ton is wasted; the net result is zero. A kilowatt-hour supplied by the water-power plant is worth just as much as one generated in the steam plant. A little attention to the hydro-electric plant's operation will save fuel in the steam plant's bunker.

Why Not Recognize Installment Selling as a Trade Policy?

HARDLY a single piece of power-plant equipment is on the market today that cannot be bought on the installment plan. The difficulty is that the offer to sell on this plan is usually the last offensive launched by the salesman. The plan of battle should be reversed and the installment selling used to begin the battle rather than to serve as a rear guard defending the retreat.

Hundreds of sales have failed of consummation simply because the factory owner could not see his way clear to place a large cash investment in new equipment. That a new boiler or engine would pay for itself in three or four years was conceded, but his cash was scarce even though his credit was high. Consequently, his ears have been shut to all sales arguments.

Suppose, on the other hand, the machine manufacturers took a leaf from the automobile builder's book of experience and boldly advertised that installment selling was a trade policy. How many more purchases would spring up over night!

Why not go still farther and accept payments out of earnings? True, this is done at times, but is not a welcomed procedure save by the exceptional manufacturer.

The installation of a machine is never justified except on the basis of decreased production costs. Since the power equipment builder does much engineering, why not in a measure guarantee the accuracy of the engineer salesman's arguments by accepting a part of the savings as installment payments until the contract price has been covered?

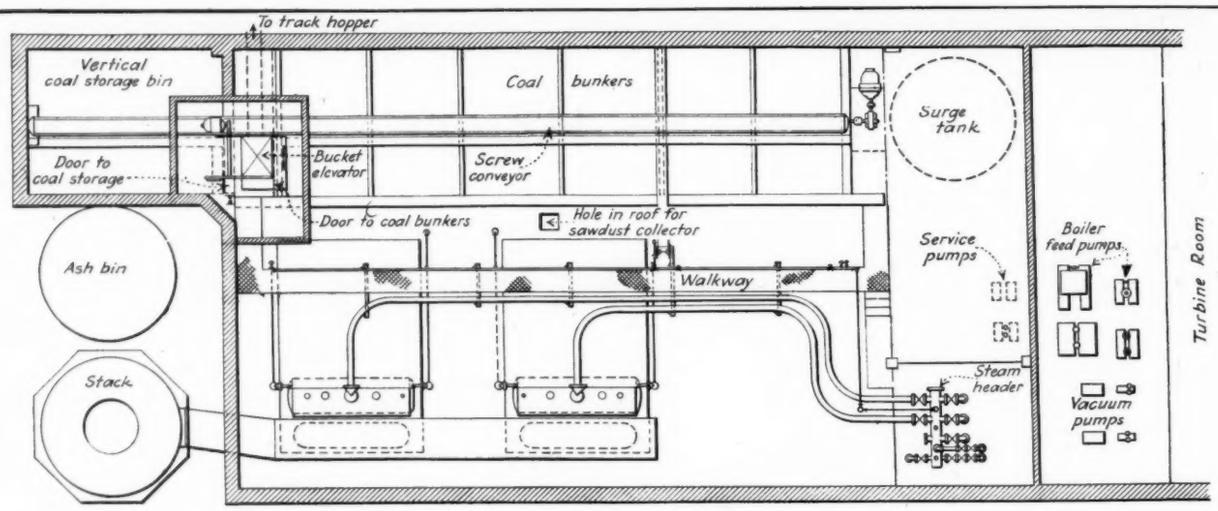
The power plant has been the backward child of industrial development. With existing machines worn out, many are buying energy even though it could be produced more cheaply on the factory premises. With a modern sales plan in existence, boiler and engine factories would not be operating at less than capacity.

Imagine the Savings!

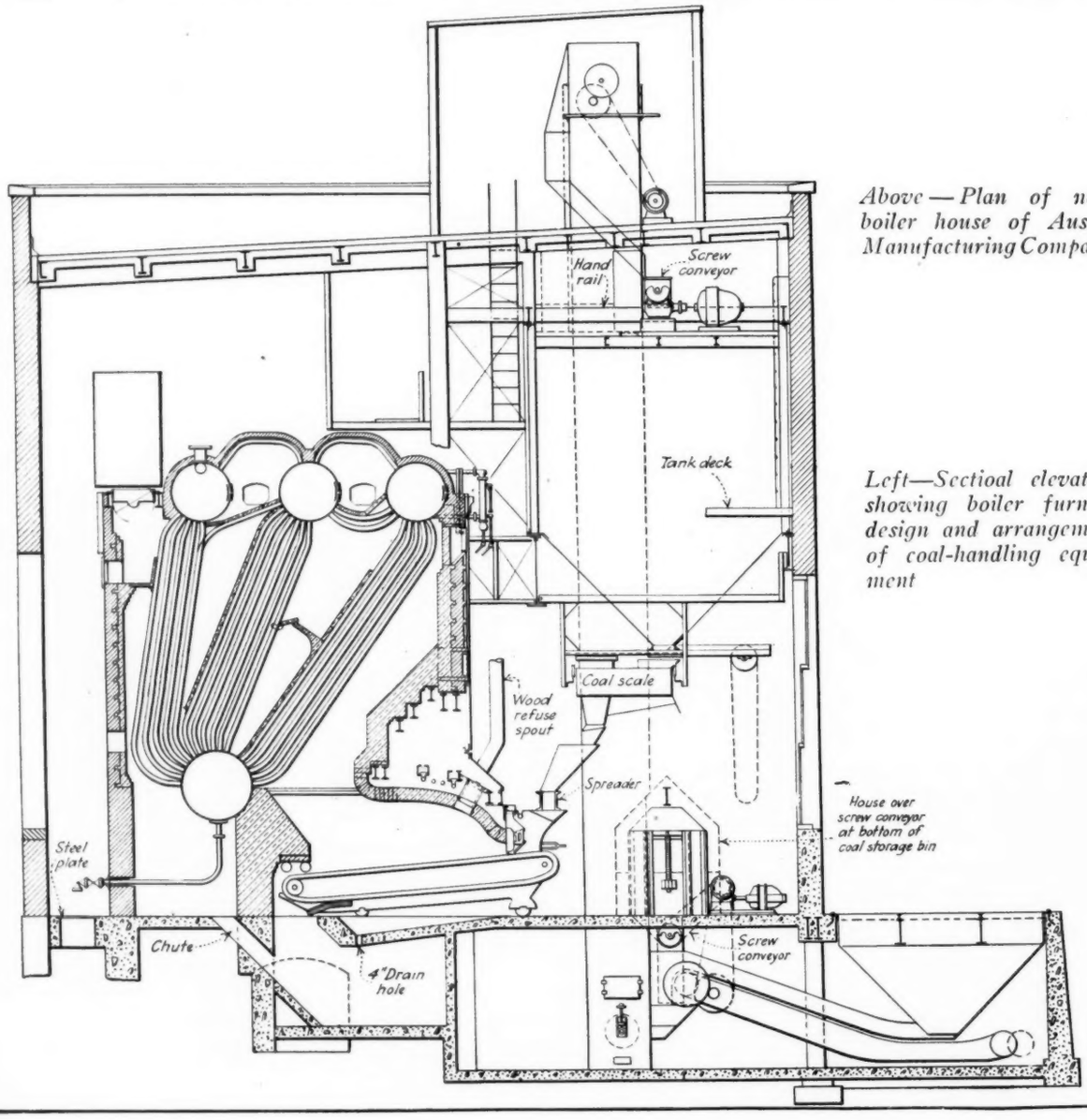
IMAGINE what a difference it would make in the efficiency and economy of the machine drives in some industrial plants if the gearing were as well selected and maintained as the gearing on the turbines in the power plant. Often, the geared drives used with production equipment seem to have been selected with regard only to the attainment of the correct machine speed. Economy of operation and maintenance are too often neglected.

Of course, the production departments of plants where such poor practice is found will argue that suitable gearing costs too much. The idea will be advanced that it is better to endure losses in power and high cost of maintenance than to run up the fixed charges by being too particular about the gears. This view, however, takes no account of the losses in production volume that follow the use of misapplied, unsuitable, but cheap gearing.

When the management of plants now permitting such wasteful practices realizes the waste that is going on, changes will be made. The selection and maintenance of gearing in the production department will be put in charge of the power engineer, who by training and experience is fitted to carry out the most economical procedure. And when this step is taken, imagine the savings that will be made!



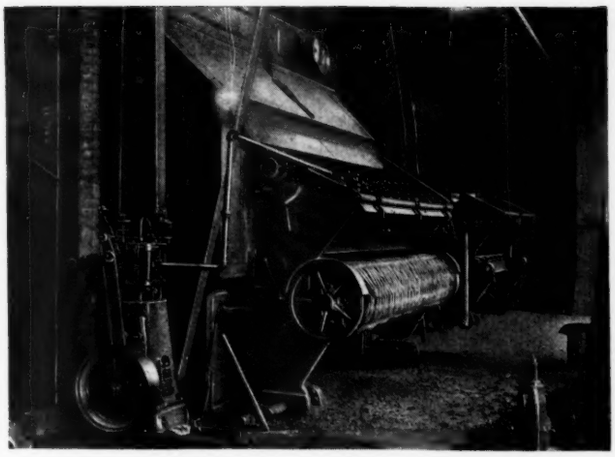
TWO MONTHS after the selection of equipment the new boiler unit was supplying steam to the plant



Above — Plan of new boiler house of Austin Manufacturing Company

Left—Sectioal elevation showing boiler furnace design and arrangement of coal-handling equipment

One of the new boilers in operation and the other under construction



Boiler House

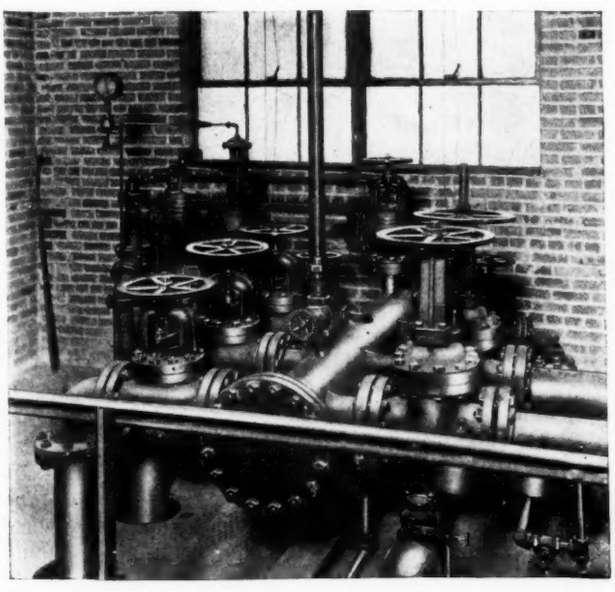
Demolished by Explosion at Harvey, Illinois

Replaced in Record Time

THERE appeared in *Power* of Nov. 15, 1927, a description of a boiler explosion at the plant of the Austin Manufacturing Company, Harvey, Ill. This plant contained three Stirling boilers, all stoker fired, and one hand-fired boiler of the same type used mainly for burning shavings. The boilers were all built for a working pressure of 160 lb. and were in a building approximately 45x95 ft. with a roof girder height of 20 ft. The explosion destroyed three of the boilers and practically the entire building, leaving the stack undamaged and one boiler adjoining it. In the same building was contained the generating plant, and the wall between the boilers and the engine room was knocked down, with damage to the piping, but no injury of moment to the equipment.

Within a day or two after the explosion the owners secured a locomotive which was placed on the track beside the engine room and provided sufficient high-pressure steam to operate the air compressors. Cables run in from a neighbor furnished enough electric current to handle the essential motors of the factory, while the surviving boiler of the original plant was provided with temporary piping by means of which sufficient heat was furnished to take care of the requirements of the factory building beyond the exhaust available from the compressors.

Short welded header on steel deck where all high-pressure valves for the boilers and the engine-room lines are located



Fortunately, the explosion occurred at a time of the year when this plant is on minimum production, the busy season starting in the late winter. The work of reconstruction was turned over to the consulting engineers on Nov. 10, the task being to build a permanent boiler house, designed for the future, but getting it into service in time to deliver the maximum factory production on regular schedule.

At the time of writing the new plant was rapidly nearing completion. While occupying the site of the former plant and utilizing the same foundations and generating equipment, it presents an entirely different appearance. All the old boilers have been cleared away. The building walls are placed upon the footings of the old building with some reinforcements. The boiler-room floor level has been raised about 20 in., and above this the new roof stands at a height of approximately 40 ft. Below the floor a tunnel extending from the front of the boilers gives a basement depth of 9 feet.

There have been installed two Stirling boilers, each containing 5,160 sq.ft. of heating surface and set with the mud-drum centers 8 ft. above the floor. Although designed for 200 lb. pressure, the boilers will be operated at 160 lb. to conform with the pressure formerly used. Each of these boilers is provided with a natural-draft chain grate having 120 sq.ft. of active area. These stokers are equipped with frame dampers, cutting off one-third of the effective grate area at will, and it is intended that one of these units shall carry the summer load, while both will be operated practically without overload during the winter. Either unit, when given entire service of the stack, will be able to carry the whole load when operated at about 170 per cent rating. As the existing stack is only 5 ft. 6 in. by 160 ft., it limits the maximum capacity obtainable.

In the main boiler room space is being provided for a

third unit to take care of any future growth. As the space available in front of the boilers is limited by conditions, the amount of coal storage in the overhead bunkers is not great. To supplement this storage a bin has been constructed occupying the available space adjoining the railroad track and opposite the stack. This concrete bin, 15x20 ft. in plan, is designed to be filled with coal to a height of 40 feet.

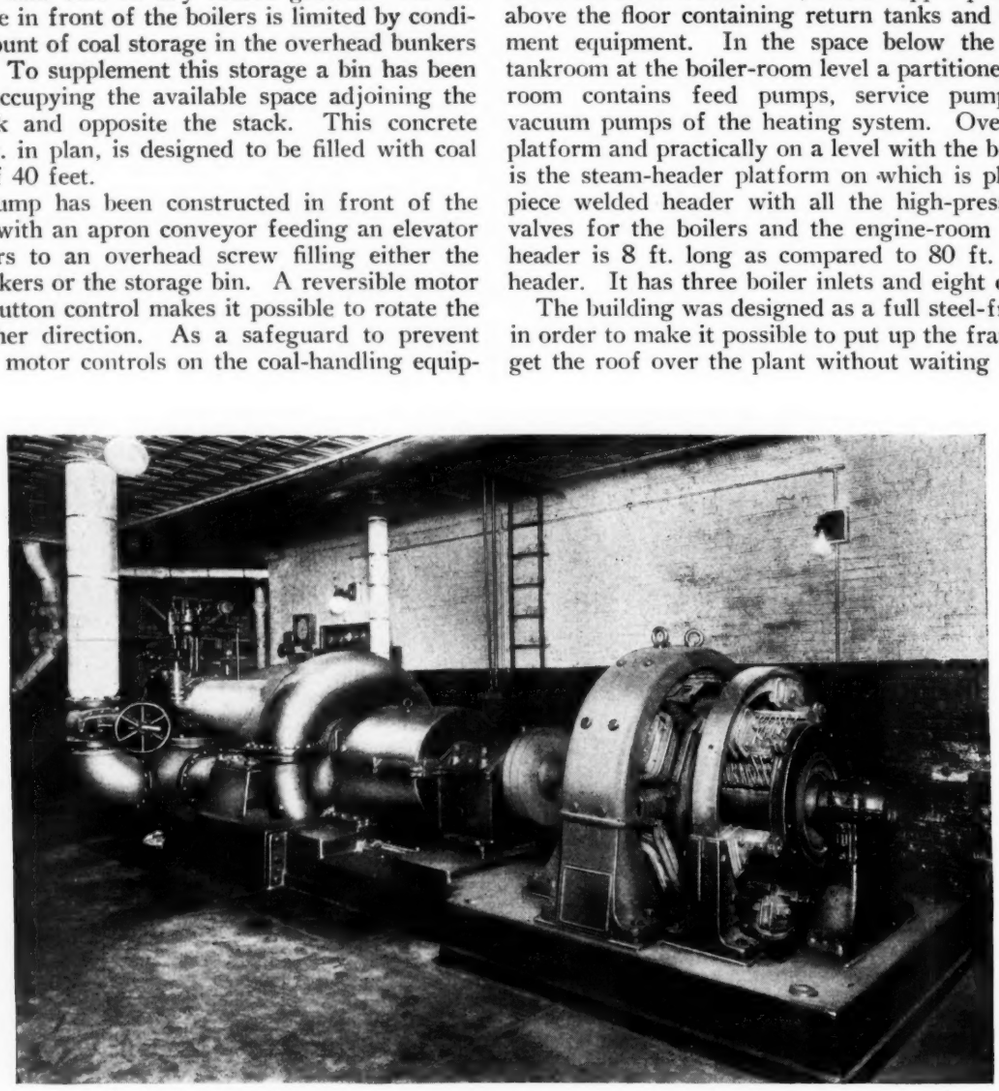
A track dump has been constructed in front of the boiler house with an apron conveyor feeding an elevator which delivers to an overhead screw filling either the overhead bunkers or the storage bin. A reversible motor under push-button control makes it possible to rotate the screw in either direction. As a safeguard to prevent clogging, the motor controls on the coal-handling equipment are interlocked, so that one conveyor cannot operate unless the succeeding one is in operation.

A second screw in the base of the storage bin reclaims coal to the same elevator. A hood or doghouse built over the screw takes the pressure of the coal in the storage bin off the conveyor and gives access from the boiler room to the vertical gates admitting coal to the screw. With the foregoing arrangement a total capacity of about 400 tons can be taken care of, one-half of which is at a level that will feed the stokers by gravity through automatic scales. Coal spreaders on the stoker hoppers prevent segregation of fine and coarse coal.

Ashes are handled by means of a steam-jet conveyor on the floor of the tunnel, discharging into an elevated cylindrical tile bin that occupies the space remaining between the stack and the coal storage.

Reference to the plan view of the boiler house shows that the two present boilers, set singly, occupy the space at the stack end of the building, with provision for a third, singly set unit in line with them. Next to this is a short bay of full-height boiler room divided into levels, the feed-water heater being on the lower platform 12 ft. above the boiler-room floor, and an upper platform 24 ft. above the floor containing return tanks and water-treatment equipment. In the space below the heater and tankroom at the boiler-room level a partitioned-off pump-room contains feed pumps, service pumps and the vacuum pumps of the heating system. Over the heater platform and practically on a level with the boiler nozzles is the steam-header platform on which is placed a one-piece welded header with all the high-pressure control valves for the boilers and the engine-room lines. This header is 8 ft. long as compared to 80 ft. for the old header. It has three boiler inlets and eight outlets.

The building was designed as a full steel-framed house in order to make it possible to put up the framework and get the roof over the plant without waiting for the construction of high side walls. As a part of the steel structure the feeding hoppers and the supports for the coal conveying equipment, together with the supporting members of the main piping, were fabricated. The roof of the building is an 8-in. tile arch resting on steel purlins. This design was selected largely because of the probable difficulties of pouring the concrete roof during winter construction.



Main 500-kw. condensing and extraction turbine-generator

All the items going into this plant had to be timed to give the earliest service possible. The selection of the boilers and the outlined design of the boiler plant was completed Nov. 22, and the boilers were ordered on that date. The manufacturer, realizing the situation of his customer, shipped the first boiler nine days after the order was placed, and it arrived before the foundations were ready to receive it. Boiler erecting was pushed as rapidly as possible, and the boiler was ready for test within eight days after the foundation was finished. Steam was delivered through temporary piping on Jan. 19. During the erecting of the boiler a temporary shed was constructed to inclose the boiler and furnace, and this shed stood until the building was constructed around

it. The same hearty co-operation was provided by all the manufacturers and contractors. The steelwork of the building was placed under contract Dec. 23 and the erecting was started on Jan. 10 and finished Feb. 13. Aside from the steel the new building was started on Jan. 25 and by Feb 21 was inclosed and practically completed.

Water supply for this plant was originally provided from a deep well in the boiler house. This well was pumped by means of an air lift and the hard water obtained treated in a softener agitated by means of compressed air. This thorough aëration probably had much to do with the internal corrosion which contributed to the weakness of the boiler that exploded. Water for the plant is now obtained from the municipality and comes largely, if not entirely, from Lake Michigan. However,

NEW EQUIPMENT IN BOILER ROOM

Boilers, two, Stirling, 5,160 sq.ft.	Babcock & Wilcox Co.
Stokers, two, Green ch. gr. 120 sq.ft.	Combustion Engineering Corp.
Boiler settings	National Power Cons. Co.
Arches	M. H. Detrick Co.
Steel structure and bins	Hansell Elcock Co.
Building contractor	George A. Nordgren
Foundation work	T. B. Hobson & Son
Piping	Kehm Bros. Co.
F. W. heater, deaërating, 27,000 lb. per hr.	Cochrane Corporation
Coal-conveying machinery	Brady Conveyor Corp.
Ash conveyor, steam jet	United Conveyors Corp.
Control equipment	Electric Controller & Mfg. Co.
Automatic scales	Richardson Scale Co.
Coal spreaders	Universal Coal Spreader Co.
Flow meters	Republic Flow Meters Co.
Dust collector	Central Blow Pipe Co.
Soot blowers	Diamond Power Specialty Corp.
Valves, non-return	Golden Anderson Valve Spec. Co.
Valves, steam	Crane Company
Valves, water	Crane Company
Valves, blowoff	Babcock & Wilcox Co.
Cocks, blowoff, gate	A. W. Cadman Mfg. Co.
Valves, safety	Crosby Steam Gauge & Valve Co.

The design of the plant and building was prepared by W. L. Fergus & Company, consulting engineers, Chicago.

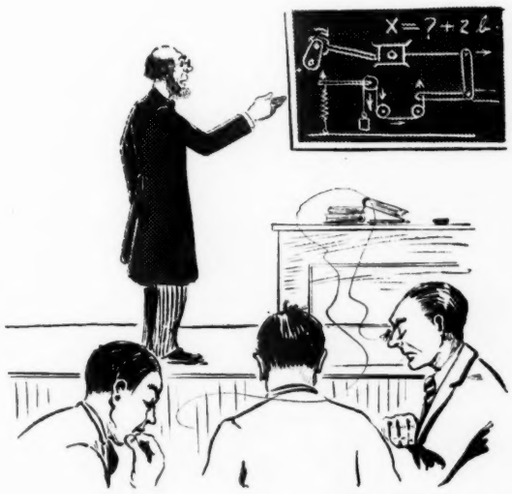
while the water is now softened without any admission of air, the returns of the feed water collected in a tank in the upper part of the boiler room are passed through a deaërating heater.

The boilers are set with a total side wall thickness of 22 in., of which 4 in. is insulating material. While the fuel for the most part is Illinois or Indiana screenings, there is a certain quantity of sawdust and shavings produced by the wood-working equipment of the manufacturing plant that must be disposed of. A dust collector therefore has been placed on the roof over the front line of the boilers and a system of piping provided by which sawdust is admitted through the arches over the stokers.

The generating equipment and the pumps were not seriously damaged by the explosion, and all this machinery is back in service. The main generating unit is a 500-kw. direct-current turbine-generator with a similar machine of 200-kw. capacity in reserve and a 100-kw. non-condensing uniflow-engine unit for night service. Both turbines are operated condensing with extraction from the larger turbine. There is more or less steam extraction at all times of the year, although mainly during the winter when the extraction is nearly 100 per cent.

A comparison of the two boiler rooms will be of interest, as it will indicate the progress that has been made in industrial plant design. Built in 1910, the demolished boiler room was a fair representative of industrial plants of that day and contained four boilers, of which three were stoker fired, in a house having a ceiling height of 20 ft. For the same load the new boiler house, with a ceiling height of 40 ft., contains two units together with a considerable investment in labor-saving equipment, not considered necessary for the earlier construction.

A second notable point in the installation is the speed with which this plant was built. The selection of type of equipment and size of units was made on Nov. 17. The first 5,160-sq.ft. boiler was put into service on Jan. 19 and, while the plant was not by any means complete, it had been entirely designed and the boiler in service was part of the final installation.



WHAT DO YOU KNOW?

By L. H. Morrison

The answers are on page 809

Ques. 1—How early can cutoff be made with D slide valve?

Ques. 2—If, in driving home a key, a lead mallet be interposed between the key and sledge, the lead gets hot, while a brass mallet will show but little temperature increase. Why is this?

Ques. 3—What is meant by "quality" of steam?

Ques. 4—What factors determine the steam-making capacity of a boiler?

Ques. 5—What is zero absolute temperature?

Ques. 6—Would you use as heavy a flywheel on a tandem-compound steam engine as on a cross-compound unit?

Ques. 7—Which will use the lesser amount of steam, a 200-hp. uniflow engine operating non-condensing with 150-lb. initial pressure or a turbine of like size operating under similar conditions?

Ques. 8—What does pH7 mean when used in the test of the acidity or the alkalinity of water used in ice tanks?

Ques. 9—Why can the efficiency of a under-water combustion process, such as the Brunler, be greater than that of the usual furnace combustion process?

Ques. 10—If the voltage drop across the primary of a current transformer in a single-phase circuit is 25 volts when the power factor of the load is 0.80, how much of a drop will this cause in the line volts?

WATER *and* COAL *as Sources of Power*

By A. A. POTTER and H. L. SOLBERG*

Dean of Engineering, Purdue University — *Ass't Prof. of Mechanical Engineering, Purdue University*

THIS is the first of a series of articles by the authors dealing with the availability of different fuels, their classification, selection, storage, properties, and utilization.—*Editor.*

WATER and fuels (coal, oil and gas) are the main energy resources for power production. In the United States the sources of energy in heat equivalents have been estimated as follows: Bituminous coal, 55 per cent; anthracite, 10 per cent; oil, 18 per cent; firewood, 6 per cent; natural gas, 4 per cent; water power, 4 per cent; animal power, 3 per cent; and windmills, 0.1 per cent. The potential water power of the world has been estimated at about 470 million horsepower, distributed as follows: North America, 65 million; South America, 55 million; Europe, 60 million; Asia, 70 million; Africa, 200 million, and Oceania, 20 million. Of this less than 7 per cent, or about 32 million horsepower, has been developed up to date.

The potential water power of the United States that can be developed without expensive storage has been estimated at 55 million horsepower, available about half the time. Of this about one-fifth has been developed and furnishes only about 5 per cent of the total power used in this country. Much of our undeveloped water power is available in sections remote from present power requirements. Thus while 79 per cent of the power requirements exist east of the Mississippi River only about 28 per cent of the potential water power is located in that section of the country. East of the Mississippi and north of the Potomac and the Ohio Rivers, only about twelve million horsepower of undeveloped water power is available, and if the total undeveloped water power of this district should be made available, it would supplant only about 10 per cent of the fuel used in this locality.

CLASSIFICATION OF FUELS

Fuels for power generation have been classified in Table I.

The relative importance of these various fuels is indicated in Fig. 1. The use of liquid fuels is confined mainly to the internal-combustion engine, although marine boilers and, to a lesser extent, stationary boilers and industrial furnaces consume an appreciable quantity. Solid fuels always have been and probably will continue to be the principal source of energy for the generation of heat and industrial power. Prepared fuels are obtained from natural fuels and in some cases are the byproducts of manufacturing processes.

ORIGIN OF SOLID FUELS

It is generally agreed that solid fuels are of vegetal origin. Prehistoric forests grew in swampy land where the trees, leaves, spores and other plant débris fell into the water and were partly decomposed by bio-chemical processes, resulting in the formation of peat. Owing to geological changes these peat beds were buried under sediment and silt, often to a depth of several thousand feet. Under the action of heat the weight of the soil above and enormous thrust pressures developed by movements of the earth's crust, the peat was slowly dehydrated, devolatilized and converted into the various grades of coal now in common use.

Cellulose, which forms the structural basis of the vegetable world, has the following analysis by weight: Carbon, 44.4 per cent; hydrogen, 6.2 per cent; oxygen, 49.4 per cent. Fig. 2 shows the various changes that have taken place during the formation of coal from cellulose. The fundamental change has been a reduction of the moisture and other oxygen compounds in the coal substance. As a result, the "older" coals are composed mainly of carbon and the total carbon content or the absence of oxygen is an indication of the extent to which the change from cellulose to anthracite coal has progressed.

TABLE I—CLASSIFICATION OF FUELS

Type of Fuel	Natural Fuels	Prepared Fuels
Solid fuels	Coal, Lignite, Peat, Wood	Coke, Charcoal, Briquets
	Waste fuels: Bagasse, Tanbark, Sawdust, Corncobs, Miscellaneous	
Liquid fuels	Petroleum	Petroleum distillates, Petroleum residuums, Tar, Alcohol, Colloidal fuel, Shale oil, Coal oil
Gaseous fuel	Natural gas	Coke oven gas, Water gas, Producer gas, Oil gas, Blast furnace gas

CLASSIFICATION OF SOLID FUELS

The United States Geological Survey recognizes the following classes of coals, in the order of their "age": Lignite, sub-bituminous, bituminous, semi-bituminous, semi-anthracite and anthracite. The term "semi-bitumi-

*All rights reserved by the authors.

nous" is unfortunate, as these coals are better than bituminous coals. The word "super-bituminous" would describe them more accurately. Although this classification of coal is in general use, it is often difficult to

TABLE II—CLASSIFICATION OF COALS BY COMPOSITION*

Class	Name	Campbell Total C÷ Total H	Frazer Fixed C÷ Vol Comp.	Muck Per Cent Total C, Dry and Ash Free	General Per Cent, Total C, Dry and Ash Free
A	Graphite and Graphitic coal	.. to ?	Anthracite	Anthracite 95	Anthracite 97—92.5
B	Anthracite (1)	? to 30	100 to 12		
C	Anthracite (2)	30—36			
D	Semi-anthracite	26 (?) to 23	12 to 8		92.5—87.5
E	Semi-bituminous	23 (?) to 20	8—5	Common Coal 82	87.5—75
F	Bituminous (1)	20—17	Bituminous		Bituminous Eastern U. S 75—60 Bituminous Western U. S. 65—50
G	Bituminous (2)	17—14.4	5 to 0		
H	Bituminous (3)	14.4—12.5			
I	Bituminous (4)	12.5—11.2			
J	Lignite	11.2—9.3		70	Under 50
K	Peat	9.3 (?) to ?		59	
L	Wood or cellulose	7.2		50	

*From "Engineering Thermodynamics," Lucke; McGraw-Hill Book Company, Inc.

determine in which group a given coal should be classified. Numerous investigators have attempted to draw definite lines of demarcation between these various grades of

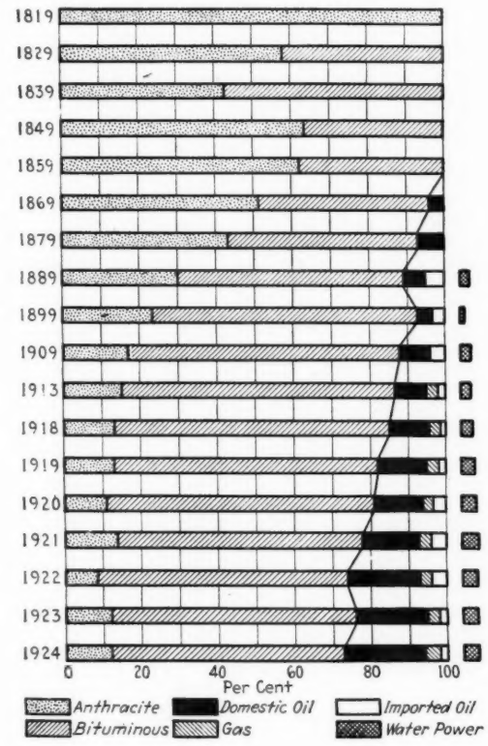


Fig. 1—Per cent of total energy supplied by mineral fuels and water power in the United States
From Haslam & Russell's "Fuels and Their Combustion"

coal upon the basis of ultimate or proximate analysis. Table II shows the classification adopted by several authorities. Such classifications, based upon analyses alone, have not been entirely successful, especially in differentiating the lower-grade fuels. Coals are composed of so many complex compounds that a mere tabulation of the proportions of their elements is not indicative of the behavior of a coal. Consequently, while the higher grades of coal may be classified fairly well upon the basis of their analyses, other properties such as appearance, behavior during exposure to the atmos-

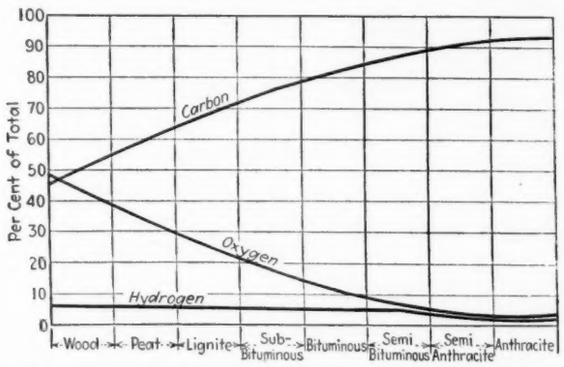


Fig. 2—Progressive transformation of cellulose into coal, based on moisture, ash and sulphur-free coal

phere, etc., are necessary to classify the lower grades of coal properly. Thus, one of the principal differences between lignite and sub-bituminous coal is that of appearance, lignite being brown and of distinct woody appearance, while sub-bituminous coal is black. One of the main differences between sub-bituminous and bituminous coal is the behavior of the coal when exposed to the atmosphere for several months. Sub-bituminous coals will quickly slack or disintegrate, the breaking up of the lumps occurring in planes parallel with the bedding.

Ralston[1] has plotted on trilinear co-ordinates, the analyses of thousands of coals on a moisture, ash, nitrogen and sulphur free basis, assuming the coal to be

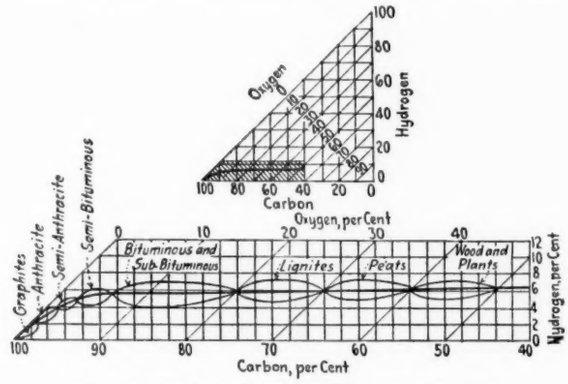


Fig. 3—Ralston's classification of coals

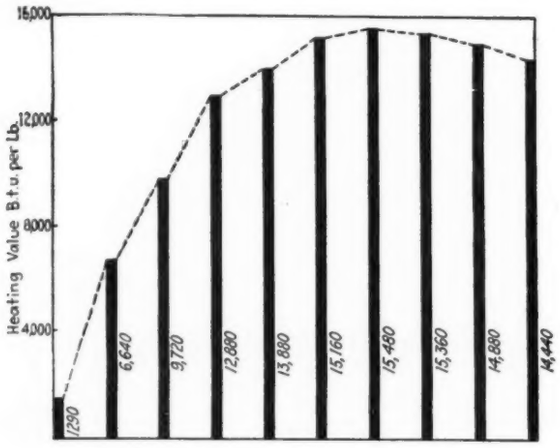
composed only of hydrogen, carbon and oxygen (see Fig. 3). These analyses fall within a relatively narrow band extending across the lower part of the diagram. The higher-grade fuel falls within definite areas, but there is considerable overlapping in the case of the lower-grade fuels. It will be noted that with the poorer grade of fuels the hydrogen content is almost constant and the carbon content varies inversely as the oxygen content. In reading this chart, the sum of the three co-ordinates at any point is equal to 100. Thus, at the junction of the sub-bituminous and lignite fields, C = 74 per cent, O = 20 per cent and H = 6 per cent.

[1]Bureau of Mines Technical Paper 93.

The variation in the heating value and proximate analysis "as received," of ash-free coals is shown in Fig. 4. Contrary to popular opinion the semi-bituminous coals have a higher heating value than anthracite. This is due to the high available hydrogen content of these fuels, since the hydrogen has a heating value of 62,000 B.t.u. per pound against 14,600 B.t.u. for carbon. The volatile matter is a maximum in the medium- and low-rank bituminous coals. These coals will produce objectionable smoke unless burned in suitably designed settings. The rapid increase in the moisture content of the low-rank fuels is one of their most serious limitations, as it is economically impossible to ship them very far from the mines.

Coal Resources of the United States

In Table III the estimated coal resources of the world are shown. The coal resources of the United States constitute about 52 per cent of the total known coal resources



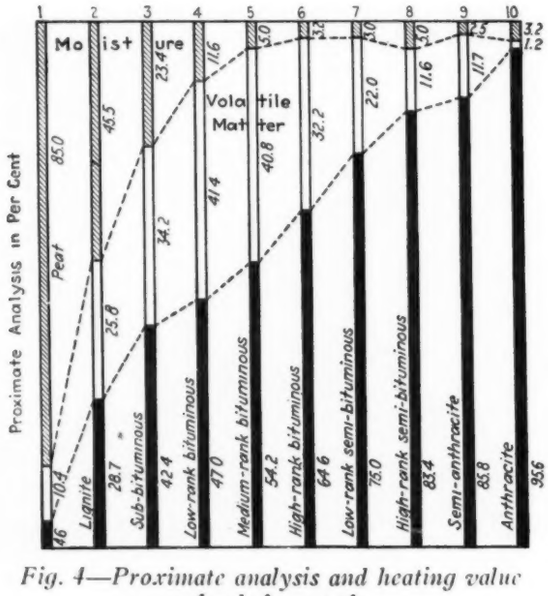


Fig. 4—Proximate analysis and heating value of ash-free coals

From paper by M. R. Campbell, U. S. Geological Survey, before International Conference on Bituminous Coal, Nov. 15, 1926

of the world. The estimated original coal resources of the United States, in short tons, are shown in Fig. 5 and Table IV.

The greatest tonnage of any single area of continuous coal-bearing rocks is 1,104,103 million tons in the Ft. Union region of Wyoming, Montana and the Dakotas; the second is 665,649 million tons in the Green River region of Wyoming and Colorado. The third is 550,989

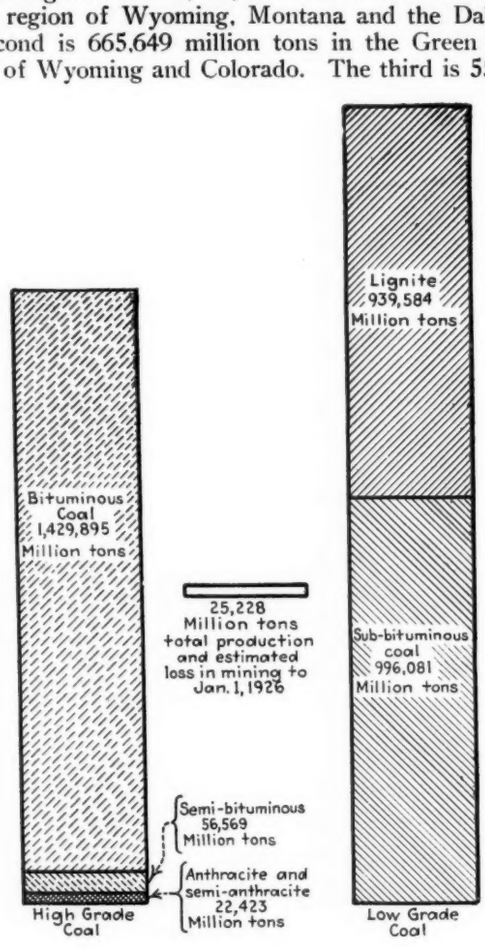

Bituminous Coal 1,429,895 Million tons
25,228 Million tons total production and estimated loss in mining to Jan. 1, 1926
Lignite 939,584 Million tons
Sub-bituminous coal 996,081 Million tons
Semi-bituminous 56,569 Million tons
Anthracite and semi-anthracite 22,423 Million tons
High Grade Coal
Low Grade Coal

Fig. 5—Original coal resources of the United States in millions of tons

million tons found in the Appalachian region of the East.

It will be noticed that the high-rank anthracite and semi-bituminous coals are a very small part of the total

TABLE III—THE COAL RESOURCES OF THE WORLD
Twelfth International Geological Congress.
Estimate is in millions of metric tons.

Continent	Anthracite	Bituminous	Sub-bituminous and Lignite	Total
Oceania	659	133,481	36,270	170,410
Asia	407,637	760,098	111,851	1,279,586
Africa	11,662	45,123	1,054	57,839
America	22,542	2,271,080	2,811,906	5,105,528
Europe	54,346	693,162	36,682	784,190
Total	496,846	3,902,944	2,997,763	7,397,553

TABLE IV—ORIGINAL TONNAGE OF COAL IN THE UNITED STATES

Kind of Coal	Million Tons
Lignite	939,584
Sub-bituminous	996,081
Bituminous	1,429,895
Semi-bituminous	56,569
Anthracite and semi-anthracite	22,423
Total	3,444,552
Total production and estimated loss in mining to Jan. 1, 1926	25,228
Tonnage available Jan. 1, 1926	3,419,324

coal reserves of the United States. However, one ton of high-rank coal may contain more heat units than 1½ tons of low-rank fuel. The total yearly coal production in the United States since 1880 is shown in Fig. 6. From 85 to 90 millions of tons of anthracite are produced annually, mainly for the domestic trade. The production of bituminous coal is over a half billion tons per year.

Up to 1925 3,478 million tons of anthracite and 13,340 million tons of bituminous coal were mined in the United States. Allowing an additional 50 per cent for loss in mining and coal left underground, this represents an exhaustion of 23 per cent of our total anthracite resources and 1.67 per cent of our bituminous coal resources. This has been removed from the finest and

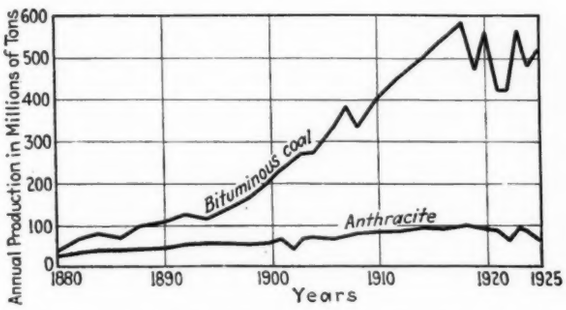


Fig. 6—Annual coal production in the United States, based on data from U. S. Geological Survey

most accessible coal beds in the country and may be called the cream of our coal resources. The life of some of the best coal fields of the country is estimated at from 50 to 100 years. As these limited resources of high-grade fuel are exhausted, it will become necessary to turn to the undeveloped fields containing poorer fuels. The economical utilization of the low-grade fuels of high moisture and ash content is a problem which is becoming more important every year.

Effect of Carbon Dioxide Ice on Fruits

SOLID carbon dioxide, which has a melting temperature of from 109 to 114 deg. below zero, recently has been receiving much attention as a possible commercial refrigerant for railway cars and cold storage rooms, as well as a protection for ice cream and Eskimo pies. A great deal has been published in the popular press to the effect that it is capable of working wonders in all lines of refrigeration.

Its great cooling power and its freedom from drip are interesting and attractive features, but the fact seems to be overlooked, says Dr. Charles Brooks, of the Bureau of Plant and Industry, United States Department of Agriculture, that the carbon-dioxide gas given off by the new refrigerant may under certain conditions be distinctly harmful to fresh fruits and vegetables. This, Dr. Brooks points out, may greatly limit the commercial field of this system of refrigeration.

When removed from the parent plant or dug from the ground, fruits and vegetables are still alive and remain alive during storage and as long as the fresh product is in a marketable condition. Like other living material, either plant or animal, they are carrying on respiration, taking up oxygen and giving off carbon dioxide, and they cannot stand great and prolonged changes in the oxygen or carbon dioxide content of the surrounding air. It has been well established in botanical literature that continued exposure of peaches, pears, apples, strawberries and cranberries to high percentages of carbon dioxide will result in the development of objectionable flavors, and it has been shown that certain storage troubles of apples and potatoes are the result of an accumulation of carbon dioxide and the displacement of oxygen. Heavy losses is overseas shipments of apples and pears have been found to be caused by an excessive accumulation of carbon dioxide in the hold of the ship.

With these facts in mind it is evident that the use of the new refrigerant can not be considered as merely a problem in physics and refrigeration but, in so far as the shipment of living material is concerned, is largely a question of the tolerance of the particular fruit or vegetable to the accumulation of carbon dioxide in the storage air. This tolerance varies with the variety and maturity of the product, and our present knowledge of the subject is far too meager to serve as a basis for commercial procedure. Under such conditions indiscriminate popularizing of the new refrigerant is untimely and may have dangerous possibilities.

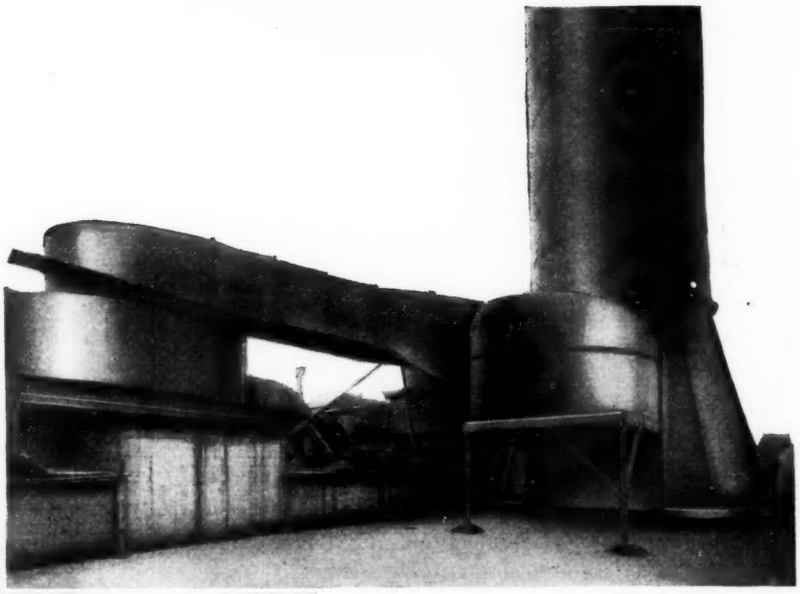
Thermodynamics as Taught in Great-Grandfather's Day

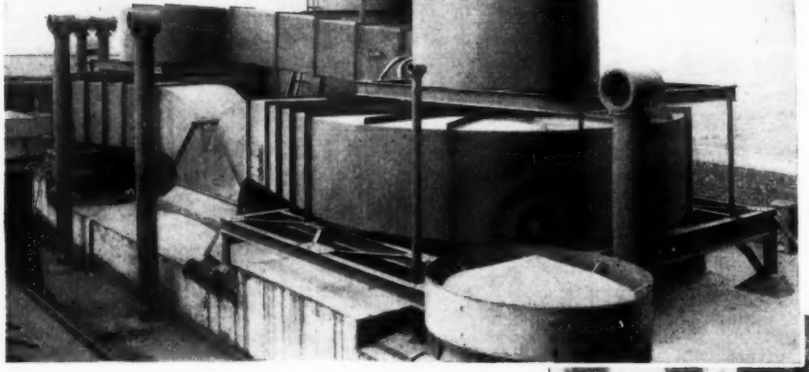
Heat is a well-known sensation which we perceive on touching any substance whose temperature is superior to that of the human body. Chemists have agreed to call that matter of heat *caloric* in order to distinguish it from the sensation which this matter produces.

Caloric is uniform in its nature; but there exist in all bodies two portions, very distinct from each other. The one is called *sensible heat,* or free caloric; the other *latent heat,* or combined caloric. Sensible caloric is the matter of heat disengaged from other bodies, or, if united, not *chemically* united with them. *Latent caloric* is that portion of the matter of heat which makes no *sensible* addition to the temperature of the bodies in which it exists. Wrought iron, though quite cold, contains a large portion of *latent caloric;* and if it be briskly hammered for some time on an anvil, it will become red hot by the action of this species of caloric, which by the percussion of hammering is now evolved and forced out as *sensible* heat.

Quoted from "The Literary and Scientific Class Book," by Rev. John Platts, published in Doncaster, England, 1821.

Installations That Are Different



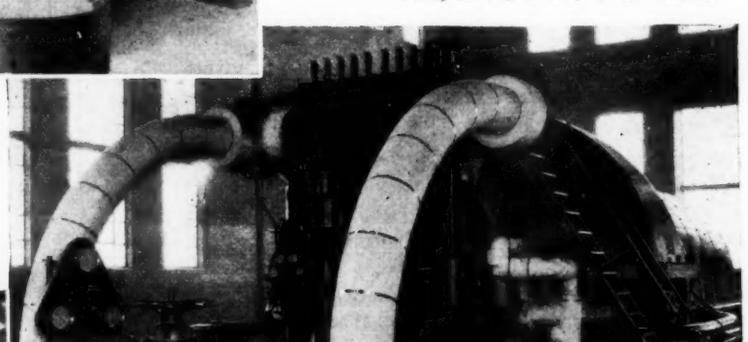


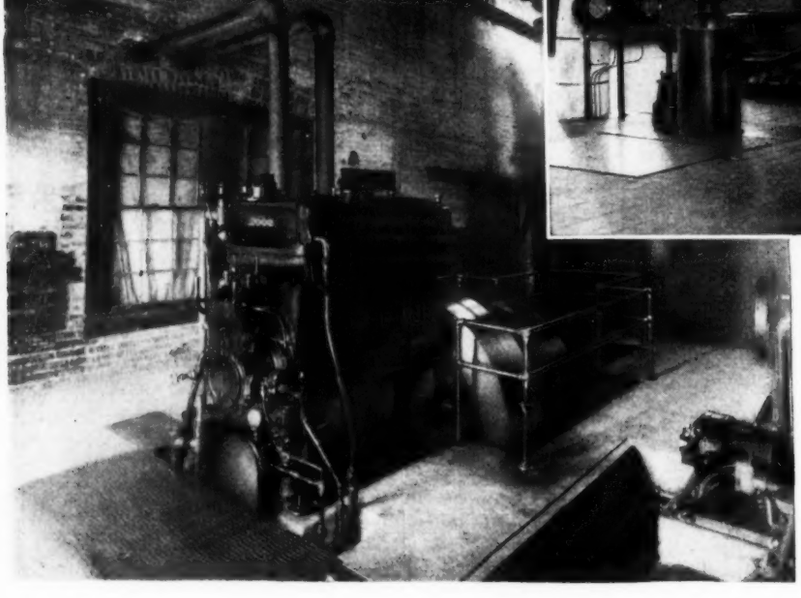
Above and Left—Sirroco dust collectors at the Calumet station, Commonwealth Edison Company, Chicago

Photo, Courtesy American Blower Company

Below—First high-speed Diesel used for peak load, installed at Berlin, Maryland

Photo, courtesy Foos Engine Company





Above—Largest turbine installed in an industrial works, a 30,000-kw. unit, Gary plant, Illinois Steel Company

Photo, Courtesy General Electric Company

Shock Method of Testing Condenser Tubes

By Lieut.-Commander H. A. Seiller
Bureau of Engineering, United States Navy

Hydro-dynamic method as employed by Navy not only locates leaks but shows up impending failures—It is also applicable to stationary practice

TWO types of tests are now in general use to locate condenser leakage—one a vacuum test and the other a pressure test with air or water as the medium. In the first a vacuum is put on the condenser and a lighted candle is passed in front of the tube sheet, close to the tube ends. The leak is indicated by the flame being drawn toward the tube. This method is not infallible, however, for a leak may be so small that there is no noticeable deflection of the flame. The pressure test is made by filling the steam side of the condenser with air or water and applying a pressure of about 20 to 25 lb. If water is used, the leak is detected by seepage. If air is used, the condenser head is filled with water and the leaks are detected by looking through an inspection plate and noting the bubbles, or by covering the tube sheet with soapsuds. In this case the escaping air forms bubbles on the tube sheet.

Both of the foregoing methods have a common fault in that, while they locate a leak after it has developed, they give no indication that trouble will soon be experienced owing to certain tubes being on the verge of failing at working pressure. In other words, in marine practice the engineer may apply either of the tests just before leaving port, but that does not give assurance that condenser trouble for the trip has been eliminated. Furthermore, after condensers have been in use several years and failures have become frequent, the engineer officer is faced with the problem of deciding whether retubing is warranted. The decision to retube is generally based on service performance in connection with an examination and test of sample tubes. The number of sample tubes drawn represents but an extremely small percentage of the number of tubes in the condenser, and the soundness of a policy under which the decision whether or not to incur the expenses of retubing is based on the result of the examination of only a few tubes, is questionable.

The necessity to devise a test that would locate weak tubes before they actually failed and thus insure immunity to tube failures for protracted periods, and to provide a means for determining the condition of all tubes in a condenser, led to investigating the feasibility of applying high-pressure tests. Testing the tubes in place hydrostatically to 1,000 lb. was first tried. It was found, however, that in this method the pressure was maintained for such comparatively long periods that the metal in many tubes, slightly deteriorated but still serviceable, was seriously strained, and while a great many weak tubes were located, the life of some serviceable tubes that did not fail was appreciably shortened. Therefore, this method was discarded.

The suggestion of applying the principle of water hammer to the tubes was next investigated, and it developed that high pressures could be applied for a fraction of a second and that these pressures caused the failure of weak tubes, but had no bad effect on the metal in the serviceable ones. This test has now been applied to hundreds of condensers, and the results have been uniformly excellent. It is called the hydro-dynamic method of shock-testing condenser tubes. Briefly, the theory of the method may be stated as follows:

Water hammer is shock produced by the arrival of a pressure wave at an obstruction in a pipe line. This obstruction may take the form of a closed end of the pipe or a wholly or partly closed valve. It may also be caused by a sudden change of pressure at any point of a pipe line full of water. The pressure wave travels through the water in the pipe at about four times the velocity of sound in air—that is, about 4,300 ft. per sec.—and there is a pressure vibration whose time interval depends on the length of pipe and also on its cross-section. The intensity of the excess pressure in the wave depends upon the amount of "extinguished velocity." Therefore, if the flow is not checked rapidly and the first pressure wave has time to travel upstream to the end and back again several times, the excess pressure is much reduced. Hence, to produce a high excess pressure means must be provided to apply pressure quickly and the tube end must be tightly closed, a small leak causing a large decrease in excess pressure.

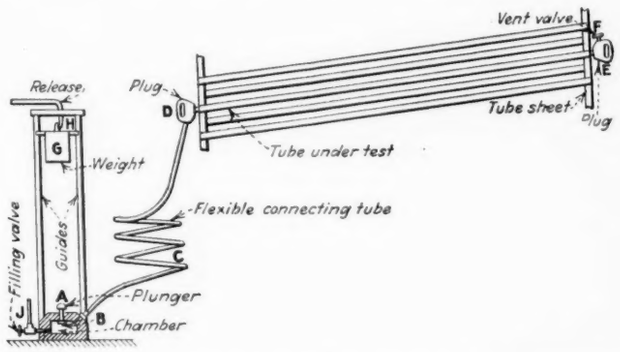


Fig. 1—Sketch of hydro-dynamic shock-testing apparatus

An outline sketch of the hydro-dynamic shock-testing apparatus is shown in Fig. 1.

It consists essentially of a cast composition base block fitted with a chamber *B*. In the top of the base block

leading to the chamber is a machined opening lapped to take the carefully machined and lapped steel plunger *A*. A flexible metal tube *C* is connected to chamber *B* and leads to a hollow tapered plug or nozzle *D* which fits into one end of the tube under test. A second similar plug *E*, fitted with an air vent *F*, is used in the other end of the tube under test. Attached to the base block are two cold-rolled steel guides. These, in connection with a weight *G* and a latch and release mechanism *H*, are so arranged

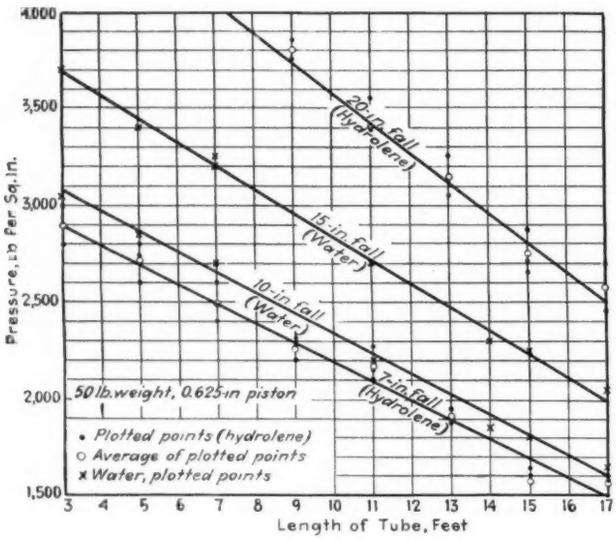


Fig. 2—Comparative pressure-length curves for different falls

as to hold the weight *G* in an elevated position and so guide it that it will impinge upon the plunger *A* when released. A connection for filling the chamber and system is made at *J*.

The nozzles that fit into the ends of the tubes should be made of a good grade of steel and then casehardened to prevent the wearing of shoulders on the tapered part of the nozzle which enters the tubes. The tube connecting the nozzle to the base block is made of copper and should be carefully annealed before using and also after testing 400 to 500 tubes. The method of conducting the test is as follows:

1. Provide all necessary tools and materials.
2. If there is insufficient room between the tube sheet and the condenser head to permit the entry of a man, remove one or both tube sheets. Wire the main injection and overboard (outlet) valves shut.
3. With a stiff wire brush clean the interior of the tube ends of all dirt and scale.
4. Set up the hydro-dynamic shock-test apparatus near one head of the condenser so that the entire tube sheet is in full view of the operator.
5. Rig either a single or double block above the apparatus for hoisting the weight.
6. Connect the filling line and copper piping to the base block.
7. Connect the water nozzle to copper tubing. Provide a vent nozzle.
8. Provide water supply either from the water mains, sanitary system or tank overhead.
9. Insert the nozzles or plugs *D* and *E* firmly into the ends of the tube to be tested, part *D* being placed in the lower end of the tube.
10. With the weight *G* latched in the elevated position and the vent valve *F* open, fill the system full of water by opening the filling valve *J*.
11. Release the weight by means of the release mechanism *H*. The weight falling on the plunger *A* produces the desired dynamic pressure.
12. Renew or plug tubes which fail.
13. Fill the condenser with water and boil for several hours by using a steam jet.
14. Apply pressure or vacuum test to locate any small leaks started between tubes and tube sheets.
15. Reassemble the condenser.

It is essential that the entire system be free of air each time the weight is dropped. To insure this, the chamber in the base block should be filled before inserting the plunger, the vent and water nozzles should be well seated in the tubes (if necessary, tap them with a rawhide mallet), and the valve in the vent nozzle must be tight. To determine whether the system is free of air, it is only necessary to strike the plunger a sharp blow with the hand. If it is firmly resistant and does not depress more than one-half to three-quarters of an inch, conditions are satisfactory. If the plunger depresses the full stroke and then springs back, there is too much air in the system. If it depresses the full stroke and does not spring back, there is a leak in the system or there is a hole in the tube being tested.

The apparatus should be so set up that the end of the tube in which the vent nozzle is inserted is higher than the other end. In filling, the water then drives the air out through the vent nozzle. This procedure aids in quickly freeing the system of air prior to each shock.

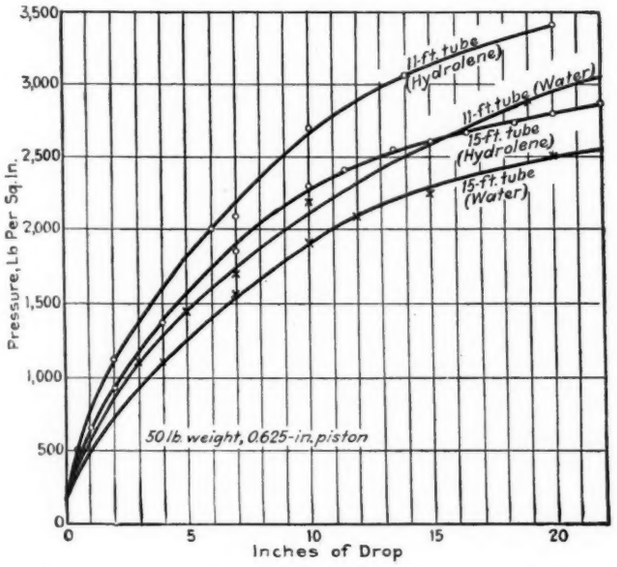


Fig. 3—Pressures for various distances of drop

Cleaning of the tube ends is essential, for dirt or scale on the interior surface will prevent the making of a tight joint between the nozzle and the tube unless the nozzle is driven in hard with the mallet. Under such circumstances both tube and nozzle are likely to be damaged. If the tubes, instead of being rolled, are packed with ferrules fitted with shoulders on the inner surface, it may be necessary to remove the regular ferrule and screw in a special steel ferrule while testing in order not to damage the tube ends. This operation will take more time, but it also acts as an aid in repacking.

The curves in Figs. 2 and 3 show the general relations between the dynamic pressure produced, height of fall and tube length, using water in one case and an aqueous solution of glycerin containing 30 per cent glycerin and 70 per cent water in another as the working fluid. Water is recommended as the better working fluid. After deciding upon the pressure it is desired to apply, it is necessary only to go to the curve and pick out the height from which to drop the weight.

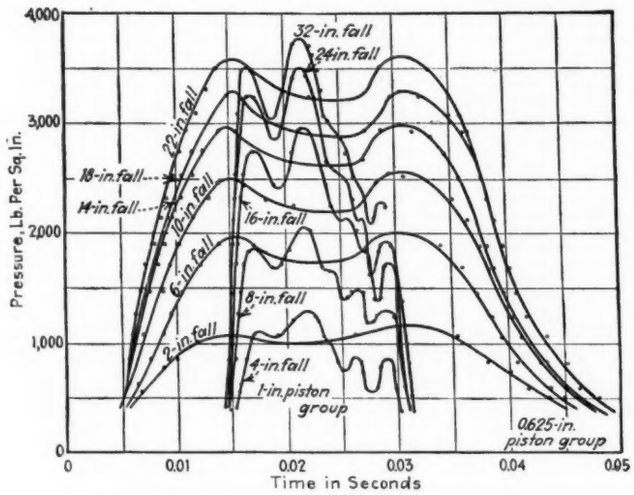


Fig. 4—Comparative pressure-time curves for 1-in. and 0.625-in. pistons

In cases where the condenser tubes have given considerable trouble due to failures caused by pitting, it is recommended that a pressure of 2,000 to 2,500 lb. be used.

Fig. 3 is a pressure-time curve showing the amount of pressure developed by dropping the 50-lb. weight from various heights and also the length of time the pressure is applied.

Another Heating Plant

Heating plants are no novelty to *Power* readers, but it's a safe bet that few of them ever heard of this one, described in a recent issue of *Nature* by W. A. Hamor, assistant director of the Mellon Institute of Industrial Research, Pittsburgh.

This plant, called *dittany* by the natives and *dictamus albus* by the highbrows, generates gas that can be lighted by a candle. *Dictamus albus,* which grows in southern Europe and central Asia, is covered with glands that secrete a volatile substance. Apparently the fluid evaporates in hot weather, making the air about the plant inflammable.

ANSWERS to "What Do You Know"

The questions are on page 801

Ans. 1—A D slide valve can have as early a cutoff as desired, but with early cutoff the steam laps and the valve travel become so large that a clumsy valve results. In addition, the steam pressure on the large valve back causes excessive frictions. The D valve is used mainly with throttle-governed engines having cutoff after half-stroke, but certain automatic governed engines use the D valve.

Ans. 2—Lead is inelastic and much of the force of the sledge blow is absorbed in displacing the particles in the lead mallet; heat results. Brass, on the other hand, is elastic, and while it is deformed at the instant the sledge strikes, the elasticity causes a return to the former dimensions, and the work done upon the brass is returned by producing a rebound of the sledge. Consequently, but little, if any, temperature rise is observed.

Ans. 3.—The "quality" of steam is generally spoken of in terms of per cent, for example, 80 per cent. This indicates that of the fluid 80 per cent is dry saturated steam and 20 per cent is water.

Ans. 4—The amount of heat liberated in the furnace, the temperature of the resulting gases, the amount of heat-absorbing surface and its arrangement.

Ans. 5—Zero absolute temperature is 459.5 deg. below zero in the Fahrenheit scale and is that temperature at which molecular vibrations are assumed to cease.

Ans. 6—A heavier wheel should be used on the tandem engine, for the variation in driving torque is greater, owing to the pressure behind the two pistons simultaneously acting on the one rod.

Ans. 7—The uniflow is the more efficient with noncondensing operation.

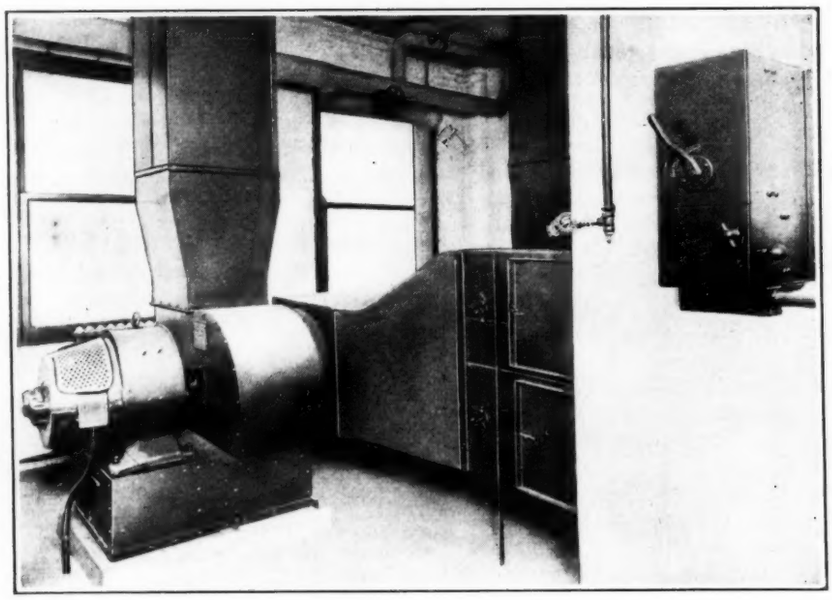
Ans. 8—The pH value shows what fraction of a gram of hydrogen ions there is in a liter of the water. The figure gives the number of ciphers in the denominator. Thus pH4 means 1/10,000 gram per liter, while pH7 means 1/10,000,000 gram per liter. Low pH value means high acidity. Neutral solutions test pH7.

Ans. 9—In the Brunler process all the gases resulting from combustion mingle with the generated steam. As a result the water vapor produced by the combustion of the hydrogen content of the fuel is not lost up the stack as in the usual boiler.

Ans. 10—On account of the volts induced in the primary of a current transformer being out of phase with the line volts, by an angle whose cosine is the power factor of the load current, the line drop caused by the primary volts is equal to primary volts times the power factor. In the problem the line drop due to the primary volts of the current transformer is $25 \times 0.80 = 20$ volts.

Tallassee Waterwheel

Attention has been called to the fact that the waterwheel pictured on page 633 of the April 10 issue is rated at 25,000 hp., instead of 50,000 hp., as stated in the caption. This wheel is one of two that will give a total capacity of 50,000 hp. to the Upper Tallassee development of the Alabama Power Company.



Exhaust fan controlled by manual starter and speed regulator

Choosing the Controller to

Suit the Motor's Load

By W. H. Costello

Engineer, Cutler-Hammer Manufacturing Company

SPEED variation under widely changing load conditions is generally more easily obtainable with direct current than by alternating-current motors. In industries where machine operations require wide adjustments in speed, direct-current motors and control predominates. Individual motor-driven machine tools are an outstanding example. Direct current serves the purpose best, because machine tools must respond to range of speed regulation not yet obtainable with alternating-current motors. The ready adaptability of direct current to dynamic braking and slow-down makes this type of motor most suitable for cranes, hoists, elevators and other material handling equipment.

Alternating current, however, has many advantages which are manifested by the steady increase in the use of this type of motor, as well as by the fact that a large part of the power sold by public utilities is in the form of alternating current. The yearly sale of alternating-current motors and controllers is far in excess of that of direct-current equipment. Various types of multi-speed polyphase motors have been developed, and these have replaced the direct-current types to an appreciable extent.

The simplest form of control is a switch which, when closed, connects the motor directly to the line, thus applying full line voltage the instant the switch is closed. It is obvious that such a starter would fulfill the condition of bringing the motor up to its desired speed in the shortest possible time. The time required to reach full speed would be determined by the starting torque of the motor and by the inertia of the motor and its connected load. Full-voltage across-the-line starters are quite sufficient for a certain group of alternating-current motors and loads and fractional-horsepower direct-current motors. This type of starter has certain limitations and a large percentage of motors required some form of reduced-voltage starter or a speed regulator, or both.

Types of Controllers

All electric controllers can be considered as being one of three forms: Manual; semi-magnet and full-magnet.

Manual-type controllers (see headpiece) have all their basic functions performed by hand, these functions being understood to include line closing, reversing, accelerating, retarding, etc.

Semi-magnet controllers have part of their basic functions performed by hand and the remainder by electromechanical devices, usually by magnetic contactors of the solenoid or clapper type. Frequently, the functions of line closing and reversing are performed by hand and accelerating by magnetic means. A common form is the familiar hoist controller, where starting, reversing and stopping are performed manually by the master switch.

while accelerating is performed by magnetic contactors. A full-magnet controller has all its functions performed by electromechanical devices, usually by magnetic contactors of the solenoid or clapper type.

Full-magnet controllers are also known as automatic controllers when the rate of acceleration is independent of the will of the operator. Most full-magnet controllers are automatic. It should be noted that the term "automatic" does not refer to the type of master switch used, but refers to the acceleration of the motor. Push-button control is a more familiar name for full-magnet control for the reason that a great many full-magnet controllers use push-button master switches. Likewise push-button control and full automatic are usually considered synonymous. Strictly speaking, there is a shade of difference in the three expressions, but any ambiguity that exists is not of sufficient importance to cause any real misunderstanding.

A large percentage of motor installations are equipped with manual controllers, principally because of the lower first cost. Automatic controllers are, however, being used in greater numbers as they have a number of decided advantages over the manual type, and furthermore, larger quantity manufacture has made possible reductions in the cost to a point where they are as low in price as manual-type starters and in some cases lower. When this point is reached there is, as a general rule, no advantage in using manual-type controllers.

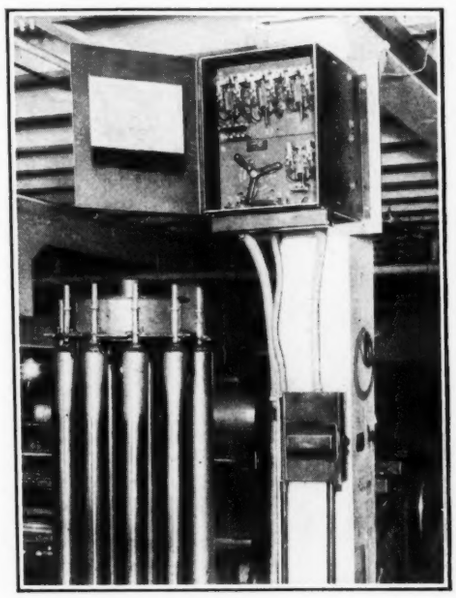


Fig. 1—Safety switch and automatic controller for slip-ring motor

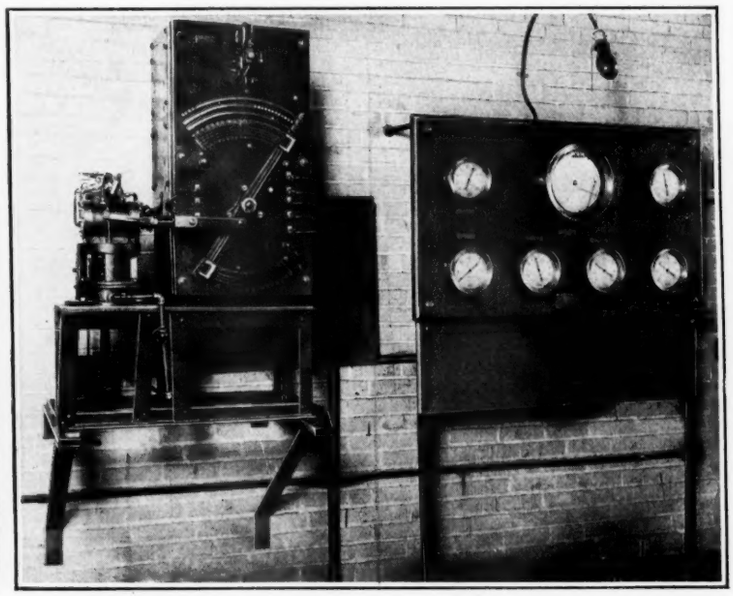


Fig. 2—Pressure controlled type speed regulator for fans driven by an adjustable-speed direct-current motor

Advantages of Automatic Control

Manual-type controllers usually show a price advantage over automatic control in the case of speed regulators requiring a multiplicity of speed points. On the other hand, operating advantages generally favor the automatic type and often outweigh any price advantage there may be in the manual control. The following advantages for the automatic type may be stated:

1. Safety—One of the main considerations in the selection of a controller should be safety. Where automatic controllers are used, the operator does not need to touch anything except the push-button or master controller. It is also possible to add safety switches, such as limit switches, emergency stopping stations, overload relays and to obtain quick stop when these devices operate.

2. Protection of Motors—When a motor is started by means of manual-type controller, it may be possible for the operator to move the starting lever so rapidly that the motor is connected directly to the line at full voltage with possibility of damage to the motor, controller and driven machine. With an automatic starter, however, the rate of acceleration is independent of the will of the operator and the motor is protected during starting.

3. Labor Saved—The use of an automatic starter often eliminates the necessity of an attendant. On some equipments the level of water in a tank is controlled by an automatic starter, used in connection with a float operated switch. Air compressors are operated in the same way, except the float switch is replaced by a pressure governor which closes a pilot circuit to the automatic starter at one limit and opens the circuit at the other.

4. Remote Control—It is frequently necessary to control the motor from a distant point, in some cases several miles away. If the manual starter was used for such an equipment, it would be necessary to have the motor wires run from the point of control to the motor. The cost of copper in this case would be high, and in addition the voltage drop over a long line might be serious. If an automatic starter is used, it is only necessary to run pilot wires from the motor to the point where the control device is located.

5. Space Saving—Space required by a controller is frequently an important consideration. If an automatic starter is used, it can be mounted in some out-of-the-way place and only the push button or other controlling device mounted on the machine. The automatic starter may be mounted directly on the motor, and in this way the wiring cost is reduced.

6. Saving in Time—With automatic control the operator simply manipulates the control device and the motor starts and accelerates automatically, thus allowing the operator to attend to the driven machine. The actual saving in time perhaps is not an important item except where the motor is driving a heavy inertia load, requiring an accelerating time of a minute or more, and also in those cases where the equipment is started and stopped frequently.

7. Ease of Operation—On relatively large equipment, which must be operated frequently, an automatic starter is often preferred because the manual starter would be large and hard to operate, while the automatic type can be easily controlled from the master station.

8. Low-Voltage Release and Low-Voltage Protection—Either low-voltage release or low-voltage protection is inherent in an automatic starter because, when the power fails, the magnetic contactor opens. With two-wire control the equipment will restart when voltage is restored, so that only low-voltage release is obtained. With three-wire control the equipment will not restart on resumption of voltage until the start button is pressed, and in this case low-voltage protection is obtained.

Low-Voltage Release

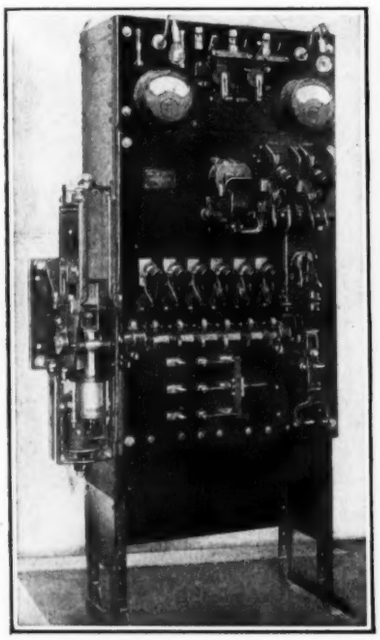
The distinction between low-voltage release and low-voltage protection is quite important, and the phrase will be found to occur frequently in controller bulletins and literature.

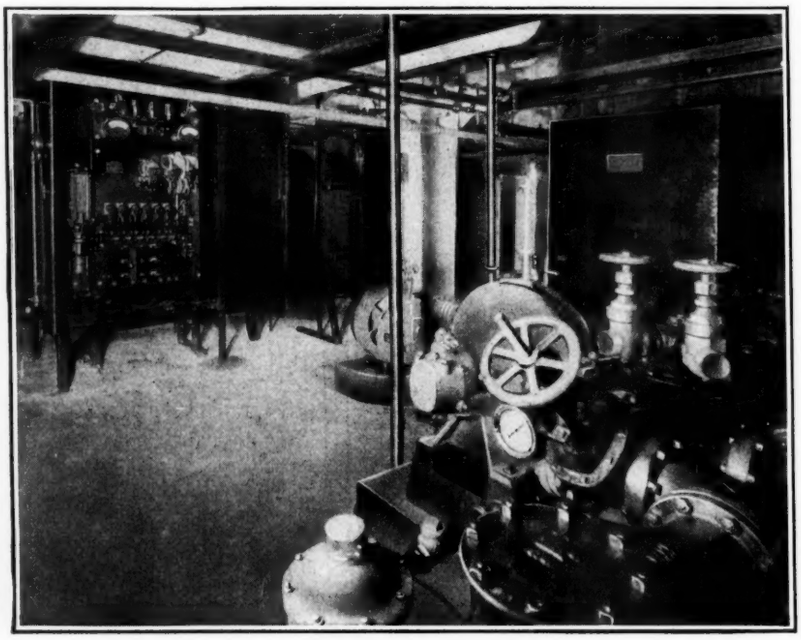
It is generally considered that low-voltage release affords protection to the motor but not to the workmen. It simply prevents the motor's being subjected to full-line voltage with all the starting resistor short-circuited; that is, the control functions to reintroduce the resistor into the circuit when the power fails. Low-voltage release should be used only in connection with motors under automatic control which are expected to start and stop without warning. Using it with motors normally under the control of an attendant or workman introduces a certain hazard.

Low-voltage protection provides adequate safety for the workman and incidentally for the motor. If the motor stops because of power failure, the attendants know there is no chance of their being hurt by an unexpected start when the power returns. The motor cannot start until someone starts it. Accordingly, low-voltage protection should be provided on controllers used with motors that are normally under the control of an attendant.

Time Limit and Current Limit

Time-limit starters are those which cause the motor's starting resistor to be cut out of circuit in a fixed time regardless of the load. If the motor is so heavily loaded that it will not start on the first point, the starter will continue to function until a point is reached where the motor starts or the circuit is opened by the overload protective devices. The timing device is usually adjusted to accelerate the motor properly under the hardest load conditions and, therefore, the time required to accelerate is longer than necessary for light loads.





Figs. 3 and 4—Alternating-current combined manual and automatic fire-pump control

Where current-limit controllers are used, the motor's acceleration depends upon the load. The accelerating current peaks are limited to certain predetermined values, and where the load is fairly constant the controllers give excellent service.

The general disadvantages of the current-limit method are that the motor may accelerate too fast on light loads and may not accelerate at all on heavy loads. If the motor does not accelerate to full speed the starting resistance will, of course, burn out. In order to insure that the motor will always start, the controller must be adjusted to operate on the heaviest loads. This means that the current peaks will be higher than necessary on the average loads, and that the speed of acceleration on light loads may be so fast as to be unsatisfactory.

Considerable difference of opinion has existed on the

part of users respecting the relative merits of time-limit acceleration and current-limit acceleration. Both have fairly well defined fields of application, with the time-limit method predominating. The success of a time-limit controller depends upon the reliability of the timing mechanism, and the principal reason for the prominence assumed by current-limit controllers for a period of time was the lack of a rugged and reliable timing mechanism. Now that reliable mechanisms are to be had, the time-limit type of control has returned to favor for many applications to which it is well adapted. Where current-limit controllers are inherently the correct type to use, they still prevail, but have been replaced by time-limit controllers for many classes of general service work.

Supplying Light and Power from Same Transformers

By A. C. McHugh

TWO 5-kva. transformers were used to supply lighting service for two buildings, from a three-phase 2,200-volt system. They were connected open-delta on the primary and single phase on the secondary, with center taps grounded to form the neutral of the three-wire system, as in Fig. 1. For the construction of a new building near by, a three-phase 220-volt service was required for the operation of a small motor-driven saw. As this load would be temporary, it was decided to supply it from the two lighting transformers, and the contractor's electrician connected them up as shown in Fig. 2. With the transformers connected that way,

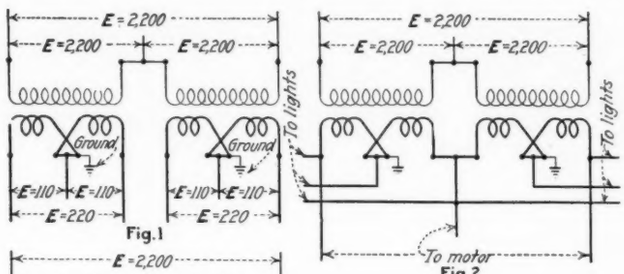


Fig. 1—Lighting transformer connections

Fig. 2—Wrong connections for light and power

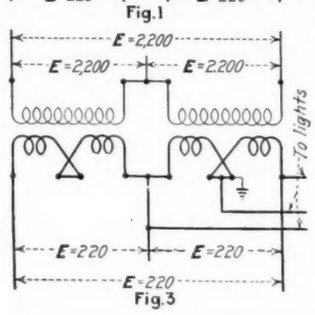


Fig. 3 — Connections used to supply light and power load

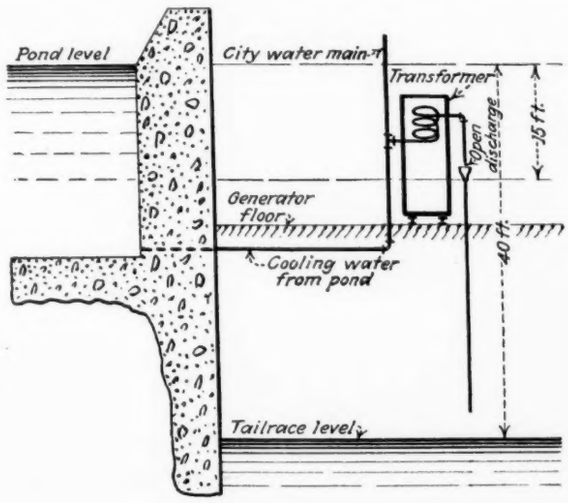
the circuit breaker opened as soon as the primary circuit was closed. The trouble was caused by the grounded center taps of the two secondaries causing a 110-volt short circuit.

As the building lighting was a night load, and did not greatly exceed 5 kw. at its maximum, it was decided to connect both buildings to one transformer, and by the use of the open-delta connection the three-phase load, which was entirely a day load, was taken care of satisfactorily. The connections were made as indicated in Fig. 3.

Applying a Draft Tube to Cooling Transformers

By J. Jacobs

IN A hydro-electric station filtered water from city mains was used for cooling transformers, at a considerable expense. In this case river water was not used, as there was not sufficient static head above the transformers, which were on the generator floor level. This is an old development that was built about thirty years



General arrangement of the transformer cooling-water piping

ago and that is one of the reasons why the generator floor level was so high above tailwater.

Only about 15 ft. out of a 40-ft. static head was available for cooling transformers with river water, as indicated in the figure. It was finally decided to do away with open-type discharge from the transformer and replace it with closed flow indicators and also submerge the lower end of the discharge pipes in the tailrace; in other words, to apply the draft-tube principle and make use of the full head. This made possible cooling the transformer with water from the pond and allowed eliminating the cost of city water.

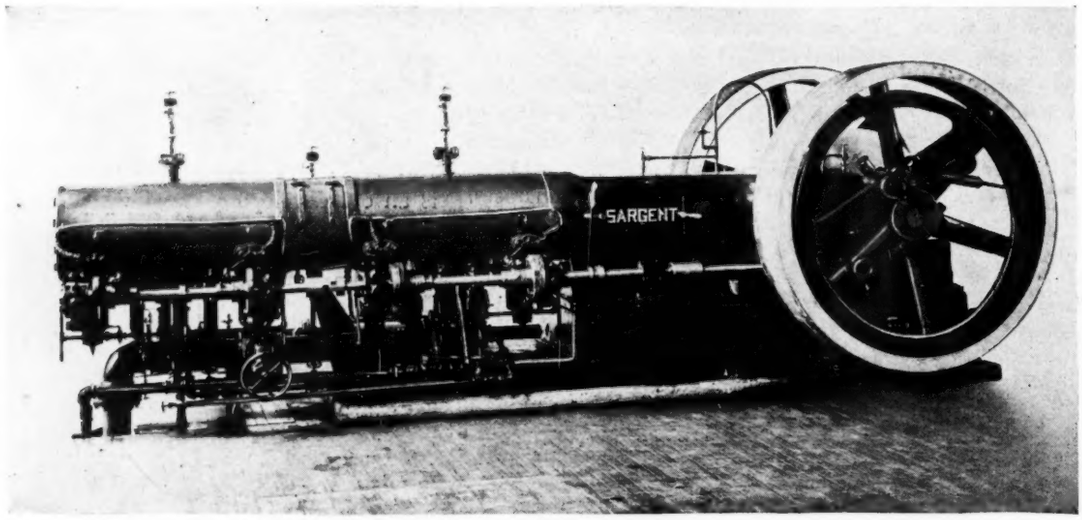
Service Restored Quickly in an Emergency

By M. E. Wagner

SYNCHRONIZING of alternating-current generators may be done in various ways, but where the machines are put on the system one at a time, they are usually brought up to speed and voltage and the speed adjusted to bring them into synchronism before closing the switch.

In one case where the exciter circuit breaker tripped out and the voltage was lost on four machines operating in parallel, the feeder switches were opened and the generators were left connected to the busbars. The exciter was started and brought up to voltage while connected to the alternators' field. When the voltage of the alternators reached near normal, the four machines pulled into step. This operation required only about three minutes, compared to ten or fifteen that would have been required if each machine was synchronized separately.

An engine using a variable intake



Cutting the Gas Consumption of an Engine

MANY internal-combustion engines operate at low loads and, as a result, at a low efficiency. This is especially true of gasoline engines on mobile equipment, including automobiles. The author outlines how the adoption of the plan of closing the intake valve before the end of the suction stroke would materially reduce the fuel consumption.

By A. E. Hershey

Department of Mechanical Engineering, University of Illinois

IN DISCUSSING various methods of improving the efficiency of the internal-combustion engine, it is easy to lose sight of the fact that it is first of all a heat engine, doing work by virtue of the expansion of heated gases. One of the most typical examples of this inaccurate analysis of the factors influencing engine performance is the generally accepted statement that the efficiency of the internal-combustion engine may be increased by increasing the compression. This fact seems so well established by both theoretical and experimental investigations that it is usually taken to be one of the basic principles of internal-combustion engine design. However, as both Goodenough and Ricardo have pointed out, the variation of efficiency with changes in compression is not directly due to the combustion starting from different initial pressures, but rather to the expansion being carried out to a greater or lesser degree of completeness; for when the compression ratio is changed, the expansion ratio is likewise changed. The maximum temperature during combustion is affected but little by the compression pressure, since it is limited in any case by dissociation and the variable specific heat of the gases. The temperature at the end of expansion, which largely determines the thermal efficiency, is directly dependent on the amount of expansion. Hence, increasing the expansion ratio lowers this temperature and increases the amount of energy of the gases which is converted into useful work.

From these considerations it seems evident that in order to attain maximum efficiency the expansion of the gases in an internal-combustion engine should be continued until the pressure has been reduced to that of the atmosphere. Such complete expansion would present numerous practical difficulties in the way of excessive cylinder dimensions and also increased frictional losses. However, with engines that operate under variable load conditions, some of this possible gain in efficiency may be realized by changing the timing of the inlet valve so that it remains open for shorter periods at light loads.

This method of engine control is the same as that used in steam engines operating with variable cutoff, the power output being limited by closing the admission valve early rather than by throttling the steam pressure. While the analogy between the two kinds of prime movers is by no means complete, since the factor of cylinder condensation is absent in the case of the internal-combustion engine, still, the success of the method as applied to the steam engine, particularly in reducing the steam consumption, seems to warrant at least a theoretical consideration of variable cutoff control for the internal-combustion engine, especially when the engine has a varying level.

The results presented here are from such a theoretical

investigation based on a method of calculating indicated thermal efficiencies for internal-combustion engine cycles developed by Professor G. A. Goodenough.[1] Only the Otto, or constant-volume combustion, cycle has been considered, since the method of load control generally employed for the Diesel cycle is, in effect, essentially variable cutoff control.

In order to have a basis for comparison, the indicated thermal efficiencies of an engine operating on the regular Otto cycle were first calculated for four different loads, the conditions corresponding to these loads being found by assuming induction pressures of 13, 10, 7 and 5 lb. per sq.in. respectively and then proceeding around the cycle. The thermal efficiencies of a cutoff controlled engine at the same loads were then calculated, part load efficiencies being found by assuming inlet-valve closure to occur at 50, 35 and 20 per cent of the total induction stroke. The point of maximum cutoff corresponding to the full load condition was taken at 65 per cent of the suction stroke. From these two sets of results the curves shown in the illustrations were plotted.

Basic Considerations

The combustible mixture used throughout was gasoline vapor with the theoretical amount of air. Combustion in all cases was assumed to be complete before expansion started. All heat loss was assumed to take place during combustion and expansion, the total loss being taken as 35 per cent of the available heat of combustion of the mixture.

In order to show the principal points in which the variable cutoff cycle differs from the conventional cycle, the indicator diagrams in Fig. 1 have been plotted from

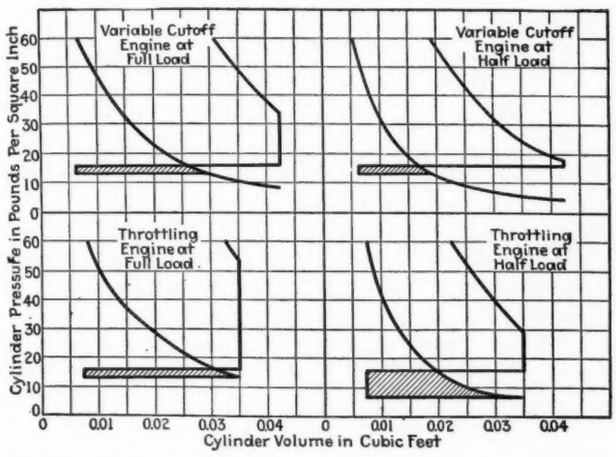

Variable Cutoff Engine at Full Load
Variable Cutoff Engine at Half Load
Throttling Engine at Full Load
Throttling Engine at Half Load
Cylinder Pressure in Pounds Per Square Inch
Cylinder Volume in Cubic Feet

Fig. 1—Indicator diagrams of the two types of engines

the calculated results. These diagrams are the low-pressure portions of the complete diagrams and correspond to diagrams taken with a light spring. The shaded area in each is the theoretical pumping loss. From a comparison of these areas at corresponding loads for the two engines, the first source of improved efficiency with cutoff control becomes evident. Instead of the pumping loss increasing with a decrease in load, as is the case with throttle control, this loss for the variable cutoff engine becomes less as the load decreases. The curves in Fig. 2 show the variation of the pumping loss in foot-pounds as the load is changing for each engine. The sudden increase below 50 per cent load for the cutoff controlled engine is due to the fact that below half load the expansion of the gases in the engine cylinder is being carried out until their pressure is below atmospheric, hence there is an additional loss due to the compression of the exhaust gases up to the assumed back pressure of 14.7 lb. per square inch.

The indicator diagrams in Fig. 1 also show the difference between the release pressure with the two types of control. The lower pressure found for the variable cutoff controlled engine is really an indirect indication

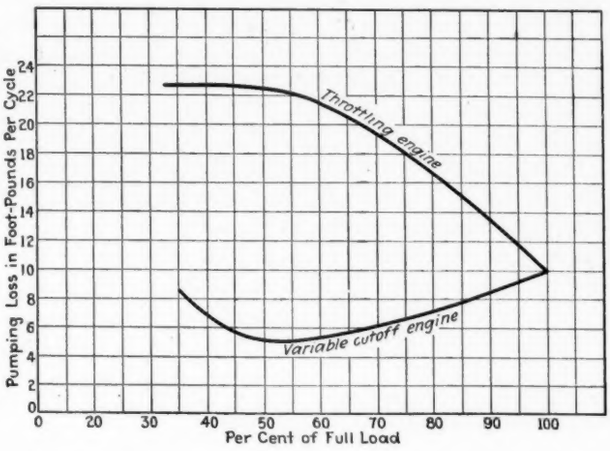


Fig. 2—Pumping loss of the throttling and variable cutoff designs

of the second source of improved efficiency. As Goodenough has pointed out, the thermal efficiency of any internal-combustion cycle depends primarily on the difference between the energy of the combustible mixture at the beginning of compression and the energy of the products of combustion at the end of expansion. The former quantity is fixed within rather close limits, but the latter may vary widely. When expansion is continued until the release pressure is nearly atmospheric, the temperature and hence the energy of the exhaust gases will be considerably less than if the pressure had only been reduced to 35 or 40 lb. per sq.in. above atmospheric pressure.

How the Efficiency Increases

The combined result of these two sources of improved efficiency is shown in the curves of indicated thermal efficiency in Fig. 3. Not only was the full-load efficiency of the cutoff controlled engine found to be about 5 per cent higher than that of the throttle-controlled engine, but the gain in efficiency was found to increase as the load decreased. This is due to the fact that while the thermal efficiency of the throttling engine was found to decrease with the load, that of the variable cutoff engine was found to increase. Such an improvement in efficiency as the load decreases is a well-known characteristic of the Diesel cycle which, as has already been pointed out, is controlled by limiting the quantity of fuel by cutoff rather than by throttling the air entering the cylinder on the induction stroke.

Next in order of importance in comparing engine performance is the mean effective pressure, since it indicates the power per unit volume of displacement which

[1] "A Thermodynamic Analysis of Internal Combustion Engine Cycles." University of Illinois, Engineering Experiment Station Bulletin No. 160, 1927.

the engine can develop. The calculated values for the two engines under consideration are shown graphically in Fig. 4. At all loads the m.e.p. of the throttle-controlled engine was found to be about 30 per cent higher than the corresponding value found for the variable cutoff engine. If both engines are to develop the same power, the displacement of the variable cutoff engine would have to be about 30 per cent greater. Such increased engine size with no accompanying gain in torque or power would be a decided handicap for the cutoff controlled engine in those fields in which high power output per unit of displacement is of first importance.

This disadvantage could be partly overcome by fixing the point of maximum cutoff at the point of inlet valve closure in the standard engine. By so doing a full-load m.e.p. equal to that of the standard engine could be obtained at the sacrifice of the possible gain in efficiency at full load which has been found for the cutoff controlled engine with maximum cutoff limited to 65 per cent.

On the whole the characteristics of the variable cutoff engine appear to be those which make it well adapted to service requiring the maximum power output at infrequent intervals. In such service an engine with this type of control may reasonably be expected to show an improved indicated thermal efficiency when compared with the efficiency of a throttle-controlled engine, the increase in indicated efficiency being from 8 to 12 per cent at loads below three-quarters of the maximum power output.

This investigation is entirely theoretical, owing to

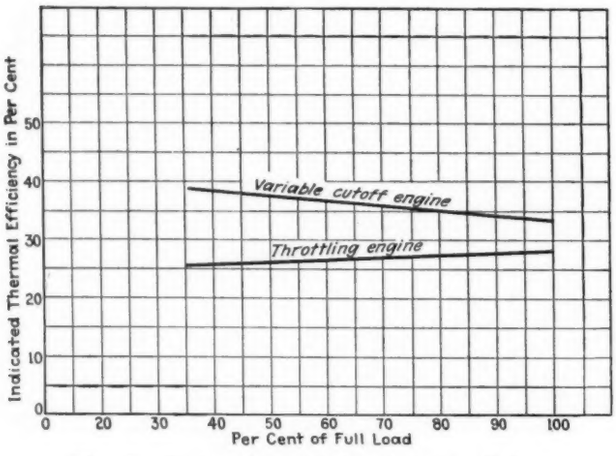


Fig. 3—Comparison of the thermal efficiency at various loads

the fact that very few experimental data from cutoff controlled internal-combustion engines are available. For this reason, only indicated efficiency and indicated m.e.p. have been considered. The mechanical losses in such an engine would doubtless be greater than those in the standard throttling engine because of the greater displacement for equal power output and because of the more complicated valve gear. However, owing to the lack of accurate information as to the magnitude of these losses, it is better to confine the discussion to the thermodynamics of the cycle alone. The only available experimental data on the more complete expansion cycle are some test results from a 10x20-in. two-cylinder double-acting tandem engine which was built and tested a number of years ago. This engine, which is shown in the headpiece, was designed by C. E. Sargent and was installed in a Chicago plant. These tests were made only at rated load, but the average indicated thermal efficiencies of 34.1 per cent agrees well with the value found for full-load conditions in this series of calculations, namely, 33.3 per cent. Such agreement

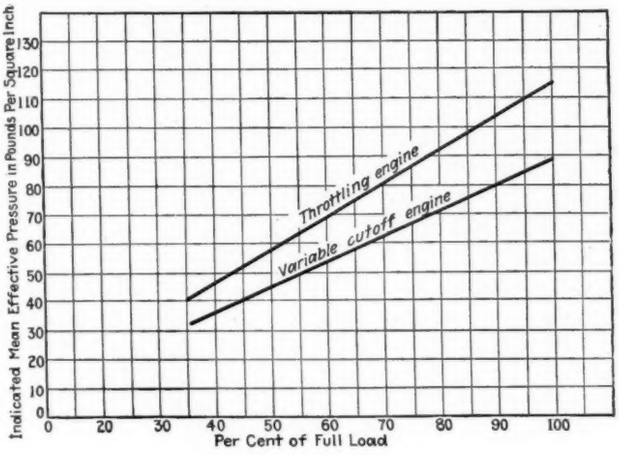


Fig. 4—Relative mean effective pressures of the two engines

between experimental and theoretical results offers good evidence in favor of the correctness of the method of analysis employed and of the assumptions made.

Letters From An Oil-Engine Operator—I

Some Remarks on Waste Heat

Dear Ed: I am glad you wrote to me about installing that exhaust-gas steam generator in your Diesel plant. I went to quite a bit of trouble to find out just what we could expect to gain as the result of putting ours in, and the boss is well pleased with the results we get. The firm that sold us this boiler said that they had demonstrated in actual test that 53 per cent of the heat that escapes at the exhaust of an internal-combustion engine can be saved with their equipment. That is probably true under ideal test conditions, but I do not think that operating conditions are always ideal; in fact, I know they are not.

It may interest you to know how we reached our present conclusions, and I think you will be safe enough in planning accordingly.

In the first place we assumed but 50 per cent of the exhaust-gas heat as being reclaimable and figured that 18,000 B.t.u. was contained in each pound of fuel oil. We considered that the engine turned 30 per cent of this heat into work, that 5 per cent was lost in friction, 40 per cent went into the cooling water and power to drive the air compressor, and 25 per cent of the heat units went to waste in the exhaust gases. This last amounted to about 4,500 B.t.u., of which 50 per cent, or 2,250, was reclaimable.

On our 1,000-hp. engine, with a fuel consumption rate of 0.42 lb. per b.hp.-hr., we consume 420 lb. of oil per hour, which represents 7,560,000 B.t.u., and the

actual heat reclaimable with this boiler would then be 12½ per cent of this, or 945,000 B.t.u. You will observe that we used conservative figures.

It appeared that we could get about 30 engine horsepower out of the steam we could produce in this way, using a single-valve engine. In other words, we could

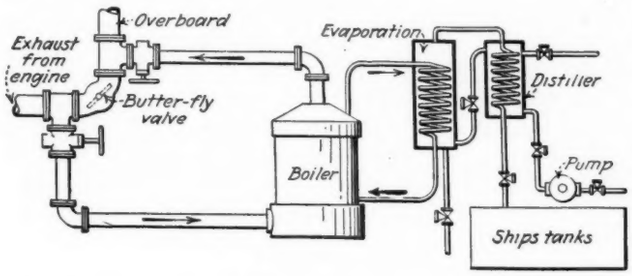


Fig. 1—Some motorships use the waste heat to supply drinking water

add about 3 per cent to the power output of our plant if we used this steam in an engine.

We did not consider this worth while. The steam is essentially low-pressure. This is true because it is necessary to obtain an easy and rapid transfer of heat from the hot gases to the water in the boiler; consequently, the greatest possible temperature difference between the gases and the steam is necessary. At first about 50 lb. per sq.in. was all we figured we could get.

Our object was to obtain steam for heating purposes and for different processes in the factory, so that 945,000 B.t.u. looked good to us if we could get it without a too high initial investment.

First, we made some little devices of our own. One of these was to put a coil in the exhaust silencer and heat water for use around the plant. Then we tried heating feed water for the oil-fired boiler we use for steam-heating purposes, but the saving was not great.

Before actually installing the exhaust-gas boiler, we thought of a number of other things. We considered the fact that when the engine was carrying fractional loads, the exhaust-gas temperature would lower quite a bit. We observed that our maximum exhaust-gas temperature was 800 deg. F. and that sometimes it went as low as 450 deg. This brought up the question whether we should attempt to generate a 50-lb. steam pressure which would have a temperature of 297 deg. F. or come down to about 10 lb. and 240 deg. With the lower pressure the differential of temperature between the exhaust gas and steam would always be greater. It was apparent that we could gain some 57 deg. by reducing the pressure, but the chief advantage would be that the low exhaust-gas temperature with fractional loads would still be high enough to permit some heat transfer.

Since our plant was operating under part-load condition, frequently bringing the exhaust-gas temperature down to around 600 deg. F., we gave up the idea of high pressure and all thought of generating power in this way was abandoned.

We installed the low-pressure steam generator, and it is giving no trouble. It works fine on the heating system, and we are getting all we expected out of it, but you see we were careful not to expect too much.

I have talked with quite a number of men who have used these boilers, and most of them are enthusiastic about the saving effected, because it really amounts to getting something for almost nothing.

You remember Charlie Coyle, who used to go to sea with us. He is chief engineer on one of the Central American Petroleum Company's tankers, and they are shooting the exhaust gases through a set of Scotch marine auxiliary boilers. With their 4,000-hp. engines they generate enough steam to heat the cargo and to pump ballast, but of course a marine engine works under full load at all times, and the exhaust-gas temperature is always up to about 750 or 800 deg. F.

Tom Waite is operating a job out in Arizona where they tried it, but the engines were always smoking. They were monkeying with heavy fuel and could not maintain clean combustion. The boiler tubes would clog up with carbon, and they had one devil of a time. I understand that they later changed over to good fuel and the plant is working all right now.

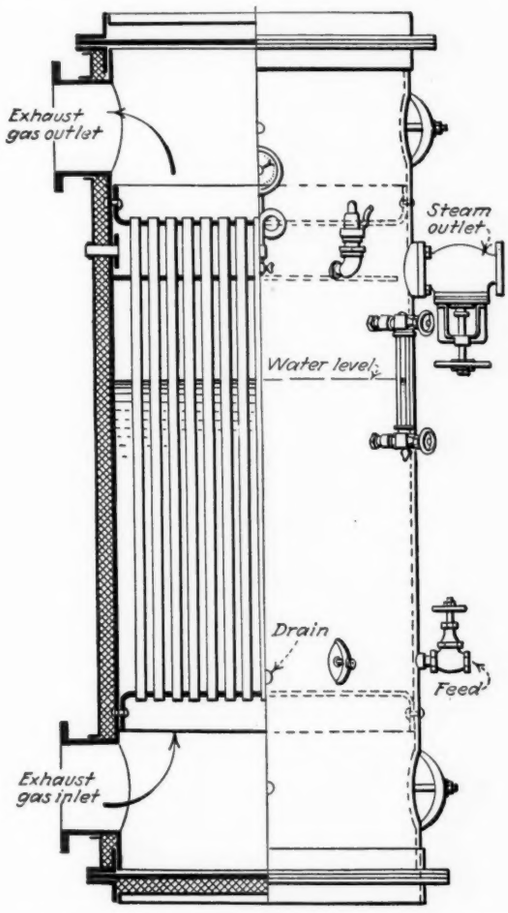


Fig. 2—A common design of waste-heat boiler

From what you tell me of your plant, I think it is worth giving it a tryout. Of course if you had a little 50-hp. or even a 100-hp. job, I would say to lay off, but with a 500-hp. engine that works well, I think you are playing safe in trying it out.

Give my best wishes to the wife and family, if there is one now.

Sincerely yours,

E. O. Leseid.

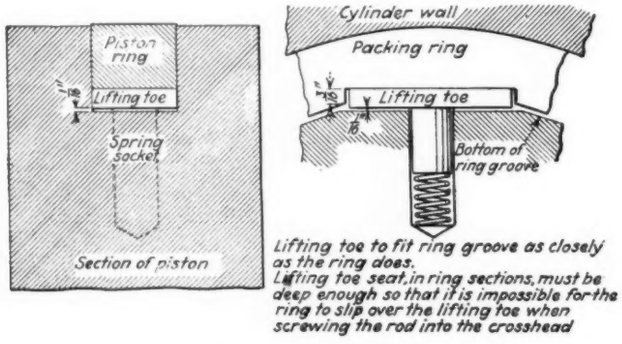
P.S.—I am including two illustrations showing two different types of heat recovery systems. I thought you might want to give these the once over.

IDEAS FROM PRACTICAL MEN

For the exchange of practical information and ingenious expedients in operation and maintenance of plant and equipment

Care Necessary When Fitting Piston Rings on Air Compressors

RECENTLY, we got into a heap of trouble with our air compressor during our yearly overhaul. It was necessary to put a new snap ring on the steam piston, and as we have been having a blow past the air piston, which was equipped with sectional packing ring we thought we would try a snap ring on the air piston as well. This was an impractical thing to do, as we realized before we


Piston ring
Lifting toe
Spring socket
Section of piston
Cylinder wall
Packing ring
Lifting toe
Bottom of ring groove
Lifting toe to fit ring groove as closely as the ring does.
Lifting toe seat, in ring sections, must be deep enough so that it is impossible for the ring to slip over the lifting toe when screwing the rod into the crosshead

Detail of ring and lifting toe

got through. With a true cylinder bore a ring turned oversize, cut, then clamped and turned to the same size as the cylinder, should perform in a satisfactory manner; but we had a worn cylinder and were in too much of a hurry to do a good job on the ring. When the compressor was assembled and put into service, the leakage was so great that the heat of compression ran high enough to set the carbon in the passages and discharge pipe on fire. Everything got red hot before the machine could be shut down.

We were now in difficulty, as the ring groove had been faced and was too wide for the sectional packing and we had nothing available to use as a shim between the two parts of the ring. After skirmishing around other establishments, we obtained a piece of sheet brass and the width of the ring was increased sufficiently to permit of its being trued on the grinder so the sides were parallel, and the groove in the piston faced for a good fit.

Next, the lifting toes under the ring were half-soled where they bore against the ring, and made a good fit in the ring groove. When assembled and started, its performance was entirely satisfactory. Sectional packing will adapt itself to a worn cylinder better than any other type of ring, but care should be taken in its construction, otherwise leakage as well as destruction of the packing may follow. The lifting toe should be a good fit in the ring groove sideways, otherwise there will be leakage under the ring on the pressure side and to the suction on the other side.

As to destruction of this sort of packing, it may come about in this way. There is sufficient space between the inside of the ring and the bottom of the groove to allow the toe to cock and slip under the full portion of the ring. This happens when the piston rod is being screwed into the crosshead, and it needs to be run this way only a short time until the job is an entire loss and the ring groove and spring sockets in the piston are so badly worn that refitting is impossible. The shoulders at the ring joint should be kept square, toe ends likewise, and the toe should be of such thickness that it is impossible for it to get out of place.

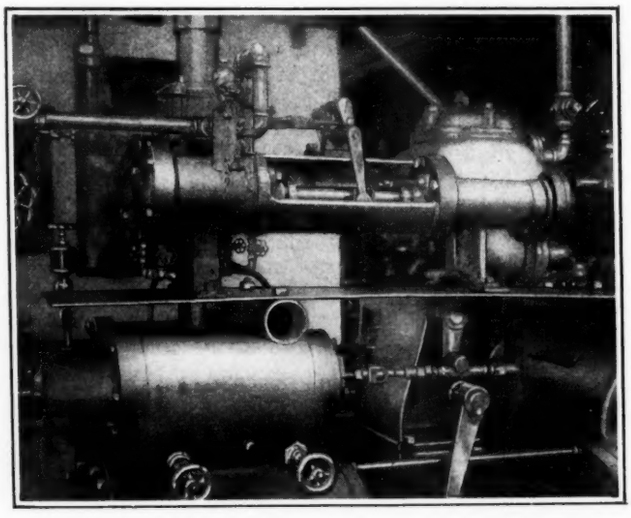
It is well to smear the cylinder wall with a light oil before replacing the piston in the cylinder, so there will be the least possible friction between the cylinder and ring while screwing the rod in the crosshead.

Anderson, Ind. J. O. BENEFIEL.

Saving Floor Space in the Pumproom

IN OUR office building the engine-room space in the basement is decidedly limited. Recently, when a new boiler feed pump was installed, the old one was overhauled and was to be kept as an emergency unit. There being no place to set it up on the engine-room floor, it was decided to place it on the top of a large emergency hydraulic elevator pump.

Accordingly, a steel plate was obtained and the pump erected as shown. The plate was drilled at one end to fit



Emergency feed pump placed on top of hydraulic elevator pump

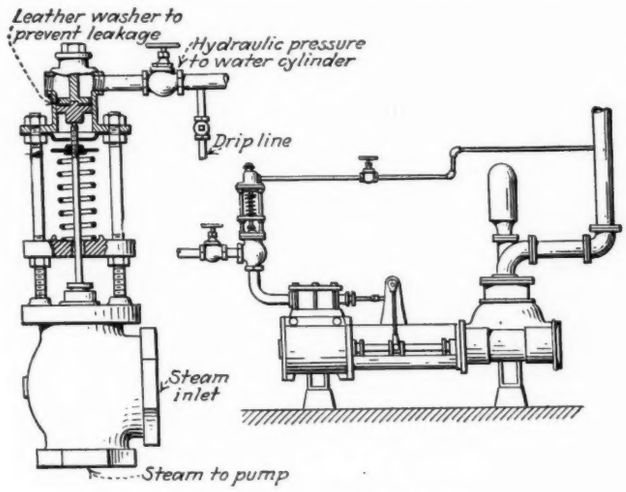
on the studs of the water chamber head, and a piece of 4-in. pipe was drilled and bolted near the other end so that it would rest on the steam chest of the large pump. After being placed in this position, the steam and water connections were made and the pump was ready for emergency service. It was often used afterward when the regular pump had to be packed or repaired. L. M. JOHNSON.

Sewickley, Pa.

Use of Oil in Pressure Regulator Improves Operation

IN CONNECTING with the operation of our hydraulic elevators a pump fitted with a regulating pressure governor is used to supply the pressure. The pressure governor always gave us considerable trouble owing to the leather washer wearing at the edges. The washers had to be changed two or three times a week and sometimes oftener.

Some time ago, while renewing the washer, it occurred to me that if oil were used in the cylinder instead of



Details of pressure regulator

water, the washer would last longer, so I decided to try it. Before inserting the piston, I filled the cylinder with heavy oil, and since that time I have had no trouble with the regulator. The present washers have been in use more than three months and show no signs of leakage to date.

T. J. HARRINGTON.

Brooklyn, N. Y.

Oil-Engine Piston Growth

IT WAS my good fortune some years back to be in charge of a power plant equipped with two old American Diesel engines. I there learned many kinks and twists that have since stood me well in the care of oil-engine plants.

One engine was fitted with rebored cylinders and the other was waiting the arrival of a set of rebored cylinders. During the wait the engine with the worn cylinders developed a heavy pound, which seemed to be in the crankbox. This box and the piston-pin bearing were both set up as closely as they would run without heating. Observation showed that the pound came and went with the increase and decrease in load and that it occurred at the end of the exhaust stroke or at the beginning of the suction stroke.

Since the bearings were known to be in good shape, we decided to pull the piston as soon as we could shut down. When the cylinder head was lifted, the first thing we saw was a badly charred piston top. The eyebolt holes were almost unusable, even after retapping, and a brightly worn band ran around the piston just below the head. We then knew where the trouble was.

This was an old piston and was to be scrapped when the new set came in. Its burned condition was the cause of overheating, and the mass had not been able to contract to its original diameter. On the contrary every day's run was adding to its diameter.

The piston was placed in a lathe and a $\frac{1}{32}$-in. cut taken down to the first groove. The center rest was then offset and a taper cut taken over all the group of ring grooves. During the remainder of its life this piston did not give any trouble, although the use of such a defective part is not to be recommended.

My conclusion, that pistons grow as well as wear, even where they have not been overheated, has been confirmed by later experiences.

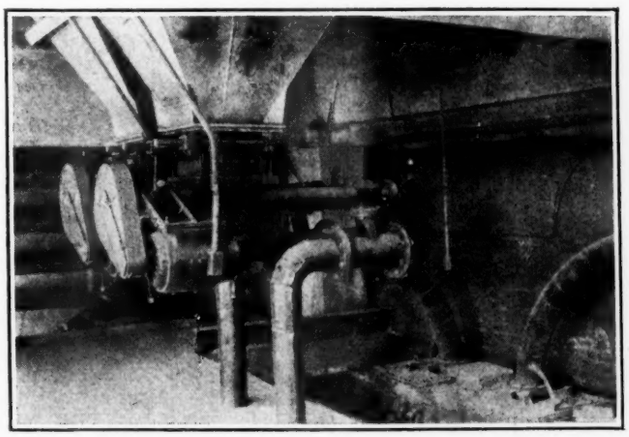
This is especially true of old two-stroke-cycle engines, where it seems unreasonable that the piston should be able to touch the cylinder head. But close inspection will locate the points of contact generally on the curve of the deflectors. A cold chisel and hammer will relieve the noise; an extra-thick gasket under the cylinder head will also relieve it. This contact is not caused by the lengthening of the entire piston, but by the expansion of the piston in the concaves and a contrary expansion of the cylinder head on the convex surfaces.

Covington, La. F. C. WILLIAMS.

Pulverized Coal Layout Prevents Shutdowns

In a Texas cement mine the two water-tube boilers are equipped with pulverized coal burners. The coal is ground at a central plant adjacent to the cement kilns, which also use the same method of coal firing. After being pulverized, the coal is conveyed to the boiler house through a pipe about 600 ft. long and is deposited in the hoppers shown in the illustration. Each boiler has a separate bin, feed screw and air blower.

To permit either of the two boilers to be kept in service



Hook up of the coal feeders

even though its own feeder is clogged or its blower is out of commission, the engineer has arranged the connections so that the feeder and air duct of No. 1 boiler can be connected to the burner of No. 2 boiler. The illustration shows one feeder disconnected from its burner line, with the latter shifted to one side. The second burner line can be coupled to the feeder in the foreground by means of a short pipe and two flanges with but a small amount of labor.

DONALD MCFEE.

El Paso, Tex.

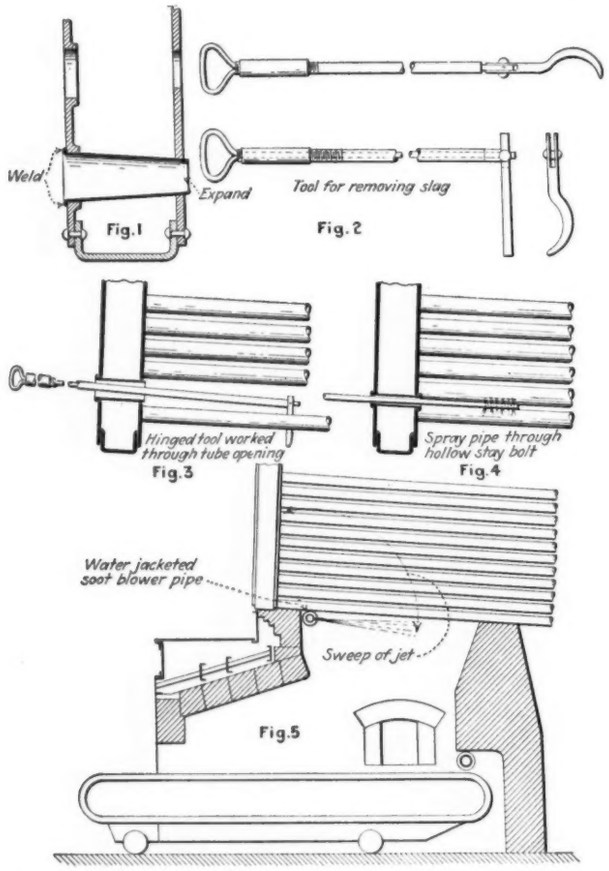
COMMENTS FROM READERS

In which those who agree and those who disagree, with either authors or editors, are afforded an opportunity to express their views

Removing Slag From Bottom Row of Boiler Tubes

IN THE March 13 issue Richard N. Seldon asks for practical suggestions on eliminating slag on the bottom row of boiler tubes. This is an extremely troublesome condition as I am well aware and occasions much loss of time and increases operating expense.

This condition became a serious one in our plant and I gave much thought to the problem in an effort to devise some means to correct it at least partly, so that I could keep the boiler in service a reasonable length of time.



Figs. 1 to 5—Tools for removing slag and high-pressure blower element in position

As the deposit was so rapid that the openings between the tubes in the lower row were almost completely closed in from 17 to 21 days, a solution of some kind became imperative. As there were no openings in the front tube header, I at first proposed to remove every alternate tube of the second row (the advantage of the second row will be apparent). The tube hole in the back header would be capped or plugged, and the front header would be fitted with a thimble extending from the tube sheet to the external sheet as shown in Fig. 1. This thimble would be expanded in the tube sheet and welded at the outer plate. Then, with a couple of tools fashioned as shown in Fig. 2, the slag could be dislodged quite readily. However, this plan met with objection, and therefore it was abandoned.

A trial was then made of playing directly on the slag with a jet of steam or water. The steam had little effect. A spray head was then made by screwing a $\frac{3}{4}$-in. pipe plug in a $\frac{3}{4}$x1-in. ell, the square of the plug sawed off, and a number of $\frac{1}{16}$-in. holes drilled in the plug. With this on a 1-in. pipe, and connected by high-pressure hose to the feed-water line, I was enabled to dislodge all that it was possible to reach through the side doors. Unfortunately, the area that it was possible to reach was limited, but the results were satsfactory. At first the hot water was used, but as the jets of water were so small, I changed to cold water, which was more effective. It was evident, from these limited experiments, that something along this line would prove a satisfactory solution, and to that end arrangements were made to have a device permanently installed which would operate and be effective over the entire area on which the slag was deposited. A rotating soot-blower element, especially designed to suit the condition, was installed at the point shown in Fig. 5. This, so arranged that steam, or water of any temperature can be used, proved to be a highly desirable installation.

The manner in which this slag is deposited is interesting. While combustion is proceeding at a rapid rate, the tubes are being bombarded with tiny globules of molten slag, and owing to the great difference in temperature between the globules of slag and that of the tube, the slag is instantly chilled and does not always, at first, stick. However, occasionally one does stick, and it, being a poor conductor, does not present such a cold surface, and succeeding drops of slag adhere to it more readily. After the tubes becomes coated with the first layer, the subsequent deposit increases rapidly, and as it becomes thicker, the outer temperature rises, owing to its poor conductivity, so the molten slag striking the now incandescent surface, fuses to it, and it will be noticed that the farther away from the tube the harder and more dense the slag is.

If Mr. Seldon's boilers should happen to be fitted with hollow staybolts, through which it may be possible to insert a $\frac{1}{4}$-in. pipe, I suggest that he try a spray pipe in that way. It will be understood, of course, that the jet is more effective when the boiler is working at a good rating, as the slag is then red hot and the sudden cooling of the outer surface causes such contraction that it breaks off quite readily, sometimes in pieces 12 to 18 in. long. If the condition should be very bad and continue, I would certainly consider the removal of alternate tubes, as suggested. The slag could be effectively removed then while the boiler was on bank, without the necessity of shutting down and cooling off, in order that the men could get in to work.

The loss in heating surface is more than compensated for by the gain in heat transmitted to the remaining tubes due to their cleaner condition. S. M. QUINN.

Chicago, Ill.

Why Boilers Explode

IS A boiler damaged if the elastic limit is not exceeded? Startling as it may seem, the elastic limit in some parts of the boiler is always exceeded in the usual tests. The maximum stress around the rivet holes is three times the average stress computed by the Boiler Code rules. Recent investigations have shown that the stress around the knuckle of the dished head and the stress around the manholes often exceed the elastic limit. This does not mean that the rules are unsafe or even incomplete for the purpose intended. It *does* show that caution must be used in going beyond the Code allowances.

It is my opinion that a test pressure of twice the working pressure is not harmful to any well designed and well made boiler, but that two and one-half times the working pressure is excessive and harmful. S. H. WILLIAMS.

Syracuse, N. Y.

* * * *

Imagined Can Be Real Savings

WITH reference to the editorial in the Jan. 3 issue, "Imagine the Savings!" it has been my experience that the possible savings are often more than is at first imagined. In the case of the loss in heat or coal due to bare steam pipes the imagined savings can be made "real," as will be apparent from the following.

It has been proved that under ordinary conditions each square foot of bare pipe surface results in a loss of approximately 3 B.t.u. per hour per Fahrenheit degree difference between the temperature of the steam or water in the pipe and the outside air. A well covered steam pipe on the other hand, will emit only between 0.3 and 0.75 B.t.u. under similar conditions. Any engineer can determine in dollars and cents these losses resulting from uncovered pipes. It is first necessary to find the number of square feet of bare pipe surface there are in his plant. This may be obtained easily from Table I, if the size and the length of the pipe or pipes are known. A table of steam pressures and the corresponding temperatures are readily obtained from an engineering handbook. From the temperature of the steam is subtracted the temperature of the surrounding air, giving the temperature difference. Thus the number of B.t.u. lost per hour is readily obtained. This figure multiplied by the number of hours that the pipes are heated during six months or even a year will give the total B.t.u. lost, which figure, divided by 970.4, will give the number of pounds of steam condensed from and at 212 deg. F. With the evaporation per pound of coal and the cost, including handling, being known, the value in dollars and cents of the steam is readily found by using the formula,

$$\text{Value of steam} = \frac{3A(t - t_1)NC}{970.4 \times 2{,}000E}$$

where

A = Square feet of bare pipe surface;
t = Temperature of the steam;
t_1 = Temperature of the outside air;
N = Number of hours steam is in the pipe;
C = Cost of coal including handling;
E = Pounds of water evaporated from and at 212 deg. per pound of coal.

In a plant, for example, carrying 150 lb. pressure absolute the temperature of the steam is found to be 358 deg. F. With the surrounding air at a temperature of 70 deg., the temperature difference is 358 — 70 = 288 deg. Each square foot of bare pipe surface will therefore result in a loss of 288 × 3 = 864 B.t.u. per hour. The loss from one linear foot of 6-in. pipe, which has a circumference of 1.735 ft., will be 864 × 1.735 = 1,500 B.t.u. per hour.

If 80 per cent of this heat be saved by covering the pipe, the saving effected will amount to 1,500 × 0.80 = 1,200 B.t.u. per hour. If steam is in the pipe 8,760 hours per year, then the preventable waste is 1,200 × 8,760 = 10,512,000 B.t.u. per year per foot of 6-in. pipe.

Assuming a heating value of 13,500 B.t.u. per pound of coal and a combined furnace and boiler efficiency of 70 per cent, the heat transferred to the steam equals 13,500 × 0.70 = 9,450 B.t.u. per pound of coal. Dividing this figure into 10,512,000 gives 1,112 as the number of pounds of coal representing the preventable waste per year per foot length of pipe. If the cost of the coal, including handling, is $3 a ton, the cost of the coal that might be saved per year per linear foot of bare pipe will equal (1,112 ÷ 2,000) × 300 = $1.67.

TABLE I—SURFACE AREA OF PIPES

Size of Pipe, In.	Sq.Ft. in 1 Ft. Length	Size of Pipe, In.	Sq.Ft. in 1 Ft. Length
1	0.344	5	1.45
1¼	0.435	6	1.74
1½	0.498	7	2.00
2	0.622	8	2.26
2½	0.752	9	2.52
3	0.916	10	2.81
3½	1.05	11	3.07
4	1.18	12	3.34

The cost of a good covering 1½ in. thick for a 6-in. pipe is about 90c. per foot. As this makes possible a saving of $1.67 per year, the saving effected will pay for the covering in (0.90 ÷ 1.67) × 12 = 6½ months. Thus it is readily seen why pipe covering for steam and hot water lines is a good investment. L. A. COLE.

Columbus, Ohio.

* * * *

What Scale Costs

GOVERNMENT statistics are always convenient pegs upon which to hang ideas or bolster up opinions. By taking up any census report and forgetting to read the footnotes, one can reach any desired conclusion. Mr. Day, in his article on "What Scale Costs," in the Jan. 10 issue, does not go quite that far, but even so the figures he quotes do not seem to bear much relation to his conclusions.

No doubt the figures as quoted are correct. I am rather under the impression, however, that 1.94 lb. of coal per kilowatt-hour is not for coal alone, but for coal and its equivalent in other fuels, making use of the standard ratio used by the Geological Survey, that is, 1 ton of coal = 4.3 bbl. of oil = 23,000 cu.ft. of gas. Evidently, this ratio is used in figuring the other results of 243 kw. per bbl. of oil and 22 cu.ft. of gas per kilowatt-hour. Best values, however, must have been taken from plants where the various fuels are used.

The conclusion drawn, showing a possible saving of $75,000,000, is, as they used it, all right for the purpose it was intended for, but it is certainly nothing for an engineer to advance as a great truth. Just what is a pound of coal? In some regions it is 8,000 B.t.u., in others 14,000 B.t.u. As far as I know Columbia station has the best operating record—about 12,500 B.t.u. per kw.-hr. If this were the best station referred to in the report with a record of 0.9 lb. of coal per kilowatt-hour, as given, this would place the value of a government pound of coal at about 14,000 B.t.u.

If now, we assume the average station was operating in Iowa on 8,000-B.t.u. coal, 1.94 lb. would be only 15,500 B.t.u., or an increase of but 24 per cent over Columbia instead of an increase of 116 per cent, as shown by the coal weight figures. For an engineer to make intelligent use of the government figures as given, it is necessary for him to study them carefully in relation to coal costs and geographical location.

It is unreasonable to expect the average stations to equal the record set by Columbia with high-pressure, reheat and base-load conditions. A consumption of 23,000 B.t.u. per kw.-hr. for a typical 10,000- to 30,000-kw. station is as good comparatively as 12,500 B.t.u. is for Columbia and, when investment, transmission charges and overhead are considered, will probably pay about the same return on the investment.

In this comparison scale plays a minor part, although we must admit that in the industrial field it is an element that must be carefully watched. It would be interesting to know the authority for the figures given in the sixth paragraph of Mr. Day's letter. They are variously quoted as "Experiments of the United States government," "government experts found," "tests by the government," etc., but I have never been able to find anyone who knows what report they were taken from.

As near as I can make out, the complete data are: To produce 100 hp. for 3,000 working hours (price of coal $1.50) costs,

With clean flues and boiler..	$1,269	100 per cent
With scale $\frac{1}{16}$ in. thick.....	1,459	115
With scale $\frac{1}{8}$ in. thick.....	1,649	130
With scale $\frac{1}{4}$ in. thick.....	2,030	160
With scale $\frac{1}{2}$ in. thick.....	3,173	250

If these data are correct, which is questionable, each one-sixteenth inch of scale increases the resistance about 15 per cent. Another set of figures sometimes quoted in boiler compound catalogs is

SCALE	LOSS
$\frac{3}{64}$ in.	9.5 per cent
$\frac{1}{16}$	12.7
$\frac{1}{8}$	23.0
$\frac{1}{4}$	41.3

These two sets of data show considerable difference. Perhaps the most authentic data along this line come from the experimental station of the University of Illinois. Last fall Professor Croft presented a paper before the A.S.H. & V.E. Some of his statements are:

> The idea that even a thin layer of scale causes an extremely large decrease in heat transference comes probably from the failure to appreciate the fact that even though the conductivity of scale is extremely low, the resistance to heat flow offered by both the tube and deposited scale is in most cases probably under 5 per cent of the total heat flow from the flue gas to the water in the tubes. . . . Obviously, then, an enormous increase in resistance to heat flow between the two films through the metal of the tubes cannot affect the over-all resistance to any great extent.
>
> Bulletin 11 of the U. of Ill. has often been quoted as giving extremely large losses due to scale. If an analysis of all the results presented in this bulletin is made, instead of collecting a few high values . . . 53.5 per cent of the tests show heat losses of not over 6 per cent.
>
> Resistance to heat flow offered by an ordinary scale formation in a boiler tube is an extremely small portion of the over-all resistance of the flue gas to the water in the tube. Therefore a relatively large increase in scale thickness can have but little effect on the over-all coefficient of heat transmission where heat transfer occurs by convection and conduction and where radiation from a fuel bed is not present.

Now we will all agree that boilers should be kept comparatively free of scale. On the other hand, it is not as bad as it is painted by any means, and it is probable that it offers both a chemical and physical protection against corrosion, a far worse evil.

Just why such examples as the steamboat, hotel and utility company are quoted without authority is somewhat vague. Examples of that kind, it seems to me, could be made to show any desired result or conditions. It is hardly reasonable to expect that boiler rooms where such conditions existed or had developed would be in a position to determine the savings accomplished. At any rate the government statistics quoted are hardly sufficient to allow any far-sighted engineer to go off on a tirade against scale. The average utility plant with a coal consumption of 1.94 lb. per kw.-hr. may be and probably is just as scale free as the most efficient one using 0.9 lb. of coal.

B. MARKER.

Los Angeles, Calif.

* * * *

Figuring Depreciation

AS IT is well known, there are two methods in general use for estimating the carrying charges to be made against buildings and machinery, the first being to charge a yearly depreciation amounting to the first cost divided by the estimated number of years of life, and in addition 6 per cent interest on the original investment, at the same time possibly making a suitable allowance for junk value.

This method is, of course, not strictly correct and makes the total interest charge too high.

The second method is based on the use of the following formula to arrive at the interest charge, and with this the foregoing method of figuring depreciation is generally used.

$$\textit{Yearly interest charge} = \frac{M+1}{M}\left(\frac{\textit{Investment} \times 0.06}{2}\right)$$

in which M represents the number of years life.

It is generally assumed that this method is at least approximately correct, but the following example will show that it will give in some cases quite inaccurate results.

Let us assume that we have a building with an estimated life of fifty years. The depreciation will be 2 per cent and the interest charge $\frac{50+1}{50} \times \frac{6}{2}$ per cent, or 3.06 per cent. This with the 2 per cent depreciation will make a total charge of 5.06 per cent.

Now it is not usual to figure any depreciation on land, so the interest charge against the property upon which the building stands will be 6 per cent of the first cost; therefore the building, which does depreciate, has a lower carrying charge than the land, which does not depreciate, and this is of course absurd.

In view of the fact that the life of the building can only be guessed, it is not necessary to apply a complicated formula with a view of obtaining results of greater accuracy that the original data, which would, of course, be merely a waste of time; but the example given would indicate that a formula giving more consistent results is required, and possibly you or some of your readers might supply such a formula.

J. O. G. GIBBONS.

Newark, N. J.

PLANT EQUIPMENT NEWS

New and improved equipment in power and industrial plant fields, and new applications of existing equipment

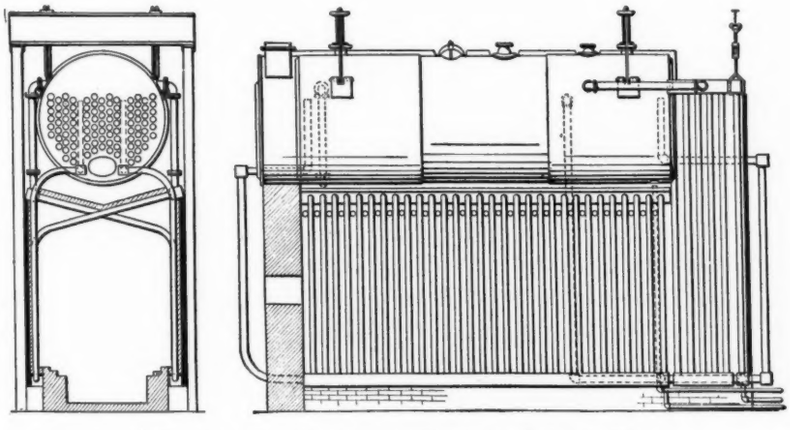
Nuway Water-Wall Boiler

IN KEEPING with developments in the engineering field toward boiler operation at higher ratings and higher furnace temperatures without the resultant high maintenance costs on refractories, the Nuway Boiler & Engineering Company, 333 North Michigan Ave., Chicago, has added side water walls to the special design of return-tubular boiler that this company has been featuring. It will be recalled that in this boiler the use of an open staggered arrangement of fire tubes coupled with return guide plates and end baffle plates tends to eliminate end circulation and causes a vertical flow of water at right angles to the flow of the gases, with appreciable increase in heat absorption and reduced uptake temperatures.

To the added capacity obtained from limited surface by controlling the circulation, still greater capacity will be available through the active surface in the water walls exposed to the radiant heat of the fire. These water walls are backed up with T-tile insulating material to reduce radiation and a steel casing to make the setting airtight. For installations designed for high pressures, the comparatively thick shell plates of the boiler are protected from the heat of the fire by a screen formed by carrying each side-wall tube across the furnace to the header on the opposite side and the laying on top of these tubes of a baffle wall of T-tile.

As indicated in the illustration, the water walls are made up of forged steel headers 9/16 in. thick, joined by 4-in. vertical seamless tubes arranged on 7-in. centers, with handhole plates at the top and bottom of the tubes. Feed to the boiler is introduced in the usual way. The side walls draw from the drum at points near the front and rear heads and discharge into the shell just above the water line.

These boilers are available in sizes from 48 in. diameter and 10 ft. long to 84 in. by 20 ft. and up to 41,500 lb. of steam per hour maximum capacity.



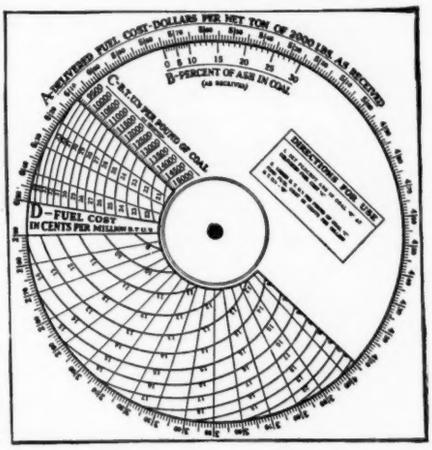
Furnace water wall applied to tubular boiler

Fuel Value Computer

A NEW form of slide rule, known as "Fuel Value Computer," arranged to make easy the calculation of the cost of fuel per million available B.t.u. when the delivered cost, ash content and calorific value are known, has been introduced by the Coal Specialties Company, 50 Church St., New York City.

Based on good combustion engineering practice, the scales are so calculated that the fixed charges that must be made against any given coal due to the ash content are automatically taken care of with one setting of the scale.

Referring to the illustration, scale *A* is plotted around a series of curves printed on a sheet of flexible material on which is mounted a semi-circular rider carrying scales for ash and B.t.u. content. In use, the delivered cost per ton (2,000 lb.) of coal is set on scale *A* against the ash content on scale *B*. Opposite the calorific value on scale *C* may be read the cost per million B.t.u. An example of the use of the computer is as follows: A certain coal is delivered at $5.70 per ton, it contains 5 per cent ash, and the calorific value is 14,000 B.t.u. The illustration shows this particular set-up and it is apparent that the cost per million B.t.u. is 21 cents.


A—WEIGHTED FUEL COST—DOLLARS PER NET TON OF 2000 LBS. AS RECEIVED
B—PERCENT OF ASH IN COAL
C—B.T.U. PER POUND OF COAL
D—FUEL COST IN CENTS PER MILLION B.T.U.
DIRECTIONS FOR USE

Computer shows cost per million B.t.u.

The back of the computer carries tables for conversion of cost on a long-ton basis to that on a 2,000 lb. basis.

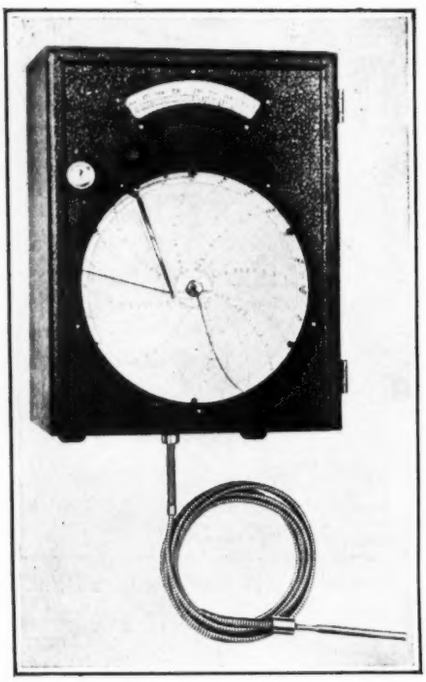
Flush-Type Cases for Continuous Chart Recorders

THE Brown Instrument Company, Philadelphia, Pa., recently announced that its Continuous Strip-Chart Instruments are now available in the flush-type case. An important feature of the new flush-type recorder is an arrangement by which the recording mechanism can be drawn out of the case at the front for easy inspection. Continuous strip-chart recording pyrometers, CO_2 meters, tachometers and resistance thermometers can now be furnished in flush-type cases with or without panels as specified. All these instruments can be supplied in a single, duplex, multiple or multiple duplex models capable of producing from 1 to 12 records on one chart.

Bristol Recorder Controller, Model 267

A NEW recorder and contacting controller is now being offered by the Bristol Company, Waterbury, Conn.

The instrument illustrated is a single-pen recording system with controller mechanism and scale mounted



Recorder controller complete with tube and sensitive bulb

directly above it. The recording pen and moving contact of the controller are each actuated by separate pressure elements which are exactly alike in construction. These elements are connected through one capillary tube to the sensitive bulb.

The controller is arranged for a contact capacity of 1,000 watts by equipping it with self-contained automatic switches. Terminals are supplied for making easy connections to line and control apparatus through conduit. To use, it is only necessary to set the control to the desired temperature by moving an index pointer over a scale to the degree to be controlled. Zero adjusters are provided for both recorder and controller pressure elements. The case is made of sheet steel and is fitted with a glass over the chart and controller scales. It is equipped with heavy lugs at top and bottom for mounting to wall or other support.

The large current-carrying capacity of this controller makes it possible to adapt the instrument to many control applications without the use of relays, typical application being the Bristol motor-operated and solenoid controller valves which may be connected directly to the terminal. Also, for electric-heating control, mainline switches may be operated without the addition of relays.

Burning Refractories with Stokers

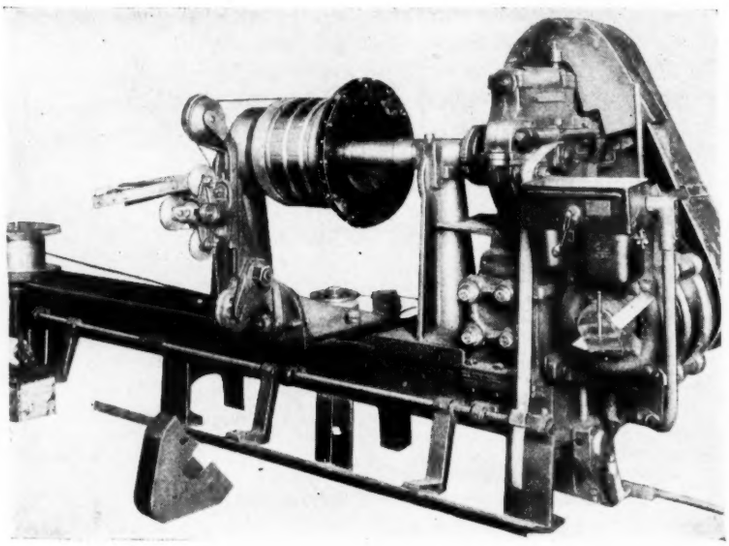
THE Massillon Refractories Co., Massillon, Ohio, has made several successful applications of a stoker manufactured by the Iron Fireman Mfg. Co., Portland, Oregon, to the firing of firebrick kilns. The heat distribution was thoroughly satisfactory, coal consumption was reduced about 12 per cent, and the cost of coal was reduced about 40 per cent, owing to the ability to burn cheaper coal. There was also a considerable saving in labor and the plant was cleaner. The ware fired in stoker-fired kilns proved to be of lighter color than that from hand-fired kilns, due probably to the fact that an oxidizing atmosphere is maintained in the stoker-fired kiln and also to the fact that with the stoker there is no formation of soot.

The experience of this firm indicates that the most satisfactory stoker setting for brick kilns is of the dutch oven type well insulated to eliminate heat losses. It is necessary to have sufficient coal burning capacity to maintain a temperature of about 2,500 deg. F.

Binding-Wire Tension Indicator for Repairing Motor Armatures

THE General Electric Company has developed a device, shown in the figure, for use in the repair of motor armatures, which indicates the exact strain or tension in pounds that is applied to the steel binding wire by the binding machine or lathe. It also provides a simple means of keeping track of this tension throughout the full operation of binding up the armature. By its use the binding wire will not be stressed beyond the elastic limit or tensile strength of the steel and will be kept under uniform tension during the process of winding it in place.

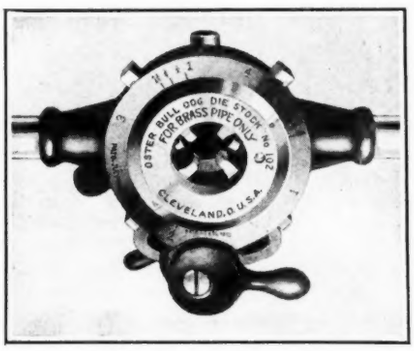
The indicator can be applied to practically any type of armature-binding machine. It is equipped with a rotary dial that can be turned to any position by loosening a nut and setting the pointer at zero so that the scale may be read at any angle. The indicator dial is accurately calibrated and graduated from zero to 500 lb., allowing the use of binding wire of any size within the range of the machine. One of the important features of the indicator is that the center pulley wheel over which the wire runs is actuated by a heavy coil spring so that when the binding machine or lathe is started and stopped, a constant tension is maintained on the wire at all loads, which prevents the wires from becoming loose and releasing the tension in the band.



Tension indicator attached to binding lathe

Oster Die Stock for Brass Pipe

THE Oster Manufacturing Company, Cleveland, Ohio, has introduced a new die stock, illustrated



Brass pipe die stock

herewith, specially designed for threading brass pipe.

Patterned after the Oster Bull Dog Die Stock, the new tool has the automatic, quick-acting dies which eliminate any necessity for backing off over the finished thread. The dies can also be quickly adjusted to cut deep or shallow threads.

The new dies are ground with a slightly different cutting angle from the standard dies used for iron pipe. A brass faceplate, stamped "For Brass Pipe Only," identifies the new tool.

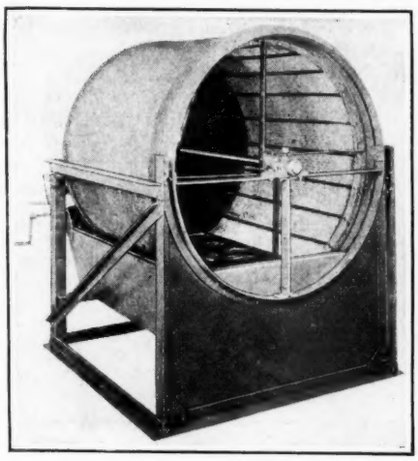
National "Simplex" Air Filter

A NEW air filter, known as the "Simplex," has been added to the line of rotary and constant effect filters put out by the National Air Filter Company, Chicago, Ill.

The new filter consists of a large cylindrical drum closed at one end and carrying a filtering medium on the outside surface. The air is drawn through to the inside of the drum and then through the open end in the direction of the fan. The filtering medium comprises layers of expanded metal for precleaning and nets of heavy twisted copper ribbons of specially woven fabric for the final stage. The coarser particles of dirt are impinged on the oily surfaces of the expanded metal, and the further particles are stopped by the copper ribbon layers.

One segment of the drum is always immersed in oil. Under average conditions the drum is turned one-fifth of its circumference once a week, and this immersion period gives the oil ample time to clean the filter thoroughly by solvent action. The standard unit is equipped with a hand crank which rotates the drum by means of a simple worm gear and chain drive. When desired, an extension shaft is furnished for the crank so that it is not necessary to enter the filter housing to turn the drum. If automatic turning is desired, a small power unit and a suitable actuating device are provided.

The oil reservoir is cleaned at intervals, the length of time between cleanings depending upon the condition of the air passes through the



Filter unit assembly

filter. The cleaning is readily done by means of a simple ejecting device built into the filter.

Standard sizes range from 800 to 40,000 c.f.m., and by using additional units any capacity can be obtained. Air leakage around the drum is prevented by a flexible seal between the moving drum and the stationary outlet head.

Transmit-O-Phone, a Sound Locater

THE usual method of detecting and locating blade rubbing in steam turbines, loose pistons, crosshead and main-bearing knocks in steam engines, and similar troubles in power-plant machinery, is by means of a pencil, rod or other device placed with one end on the machine and the other end in the ear or between the teeth. With a view to simplifying this part of the engineer's duties and making it possible for him to locate more readily and accurately the exact position of the knock, the improved twin model Transmit-O-Phone illustrated has been recently introduced by the International Metal & Specialty Company, Berlin, N. J.

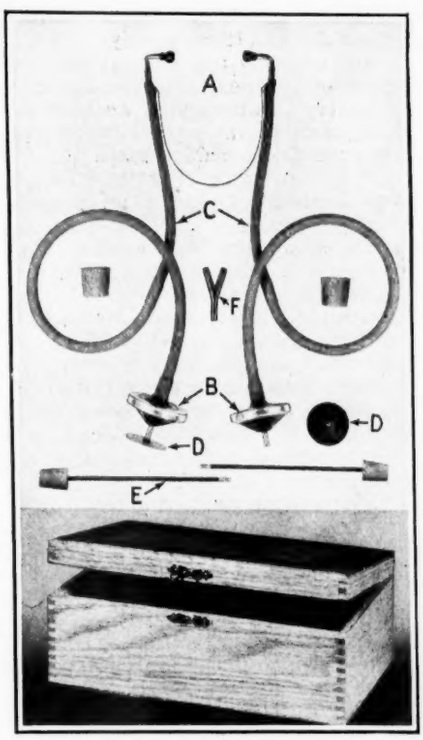
The instrument consists essentially of the headpiece *A*, twin amplifiers *B*, with connecting hose *C*, vibration disks *D*, and sound-transmitting rods *E*, with corks to clarify and cushion the sounds.

The advantage of the two amplifiers over one, as generally used on instruments of this kind, is that the location of the knock is more readily determined, and it permits the operator to distinguish two different sounds in close proximity to each other or to detect sounds from two different points at the same time.

The ear tabs are offset to fit snugly and evenly in each ear, and to keep out external sounds. The disks *B* are used for locating light sounds, and the rods *E* with the cork tips for sharp or loud sounds, the corks having a cushioning and clarifying effect. The Y-piece *F* is used where one amplifier only is necessary to locate the sound.

Among the uses claimed for the instrument, in addition to those already mentioned, are detecting leaky steam valves, loose journals, leaky steam traps, leaks in air and water lines, and locating hidden pipes and conduits.

The instrument and attachments come packed in a hardwood case.



Transmit-O-Phone with attachments and case

Our Gravest Business Problem is Waste in Distribution

SAYS DR. JULIUS KLEIN

Director, U. S. Bureau of Foreign and Domestic Commerce

YEARLY loss through inefficient distribution estimated as equivalent to one and one-half times the value of our whole foreign trade. Regional and industry studies now being made by Department of Commerce.

THE business community of the country has been so absorbed with the commendable tasks of waste elimination, standardization, simplification, and the various other elements in manufacturing efficiency that it might seem to the average observer that there could be no outstanding problem of unusual gravity which had escaped assault and at least very substantial if not entire solution. But there is such a one, and it looms up with compelling magnitude. The wastefulness of our distribution system is beyond question the outstanding issue now before the industrial and commercial world.

It is true that we have made some definite headway within the last two or three years against a few of the more flagrant wastes in selling, but it took the depression of 1921 to awaken the business world to the fact that the needs of war had concentrated everyone's energy upon production, to the almost complete exclusion of any economies in distribution. It was only when the grave necessity arose of taking in the slack of inflation, that the unpleasant discovery was made that we knew less, very much less, about distributing goods than we did of making them.

Numerous agencies are now more or less frantically trying to make up for lost time in respect of analyses, surveys, researches, etc.; some of them have made conspicuous contributions. But a canvass of any group of business executives selected at random would reveal far greater interest in lower costs per unit of output, greater volume per worker, betterment in quality and performance, and a hundred other similar items on the production side, than in any vigorous attacks upon the costs of distribution.

There is no question about the proficiency of our productive methods. The output of each worker in our industries has increased 50 per cent in the last 25 years. In some cases the progress has been even more impressive—247 per cent since 1914 in the case of the automobile industry, and 300 per cent in tires during the same period. Incidentally, it is interesting to note that the eagerness of German industrialists to adapt American rationalization plans to their industrial needs has brought about somewhat similar results; but, as in the case of our industries, the advance in quantity output has in all too many cases run ahead of actual corresponding returns in profits. In fact, German observers are already referring to their business year during 1927 as a "quantity boom," somewhat after the manner of the comment in some American journals on our alleged "profitless prosperity."

It is not an easy task to establish even approximately our losses in distribution, for the simple reason that there are only the vaguest guesses available as to the total volume of our domestic trade. The one most commonly cited is approximately eighty billion dollars. If we estimate the losses through inefficiency to be only 10 per cent, a conservative figure suggested by the calculations of engineers appointed in 1927 by Mr. Hoover to outline his campaign on waste elimination, the result would reveal a loss of eight billion dollars through this medium—one and one-half times the nation's much discussed export trade.

A host of new factors have come to the fore in our distributive machinery since the War, which have not only made it immeasurably more complicated, but have added correspondingly to the difficulty of appraising its weaknesses. Time after time various earnest trade organizations have made determined assaults upon some phase of the problem in their special fields, only to be overwhelmed by an entirely new development in distributive machinery.

In these days of uncertainty as to the outlook for certain industries or trade areas it is doubly important that every effort be made to eliminate every item of unnecessary expenditure. The fundamental philosophy of lowering prices so as to increase consumption, of minimum margins of profits and mass turnover, which have been so conspicuous an item in the success of many of our industrial undertakings, can be applied with equal effect to distribution. But such application is obviously impossible unless our distributors match our producers in the scrutiny of details in cost and the complete efficiency of their respective processes.

Today every prosperous manufacturer knows accurately each item of his costs. But can we safely make the same statement of our distributors? It is certainly the exception rather than the rule for any establishment to have its sales costs accurately distributed by percentages as among its various commodities or items such as warehousing, delivery, advertising, clerical hire, traveling salesmen, market analysts, etc.

Recent tabulations by a responsible research agency of the income-tax returns of seventeen groups of corporations in industry and trade for 1925 have revealed some interesting facts. It is true that 1925 was only a fair year and the more recent period has been decidedly more profitable; nevertheless, it can be taken as a typical point in the post-war development. The data show a profit of 5.8 per cent for manufacturing, 5.7 per cent for amusements, 12.5 per cent for banking, 5.7 for mining, 4.6 for construction, etc. But far below, at the very bottom of the list, save for agriculture, is retailing and wholesaling, with a profit of only 2.2 per cent.

There has, of course, been a substantial improvement in the general situation during 1926-27. But it is clearly evident that these figures must be reduced if the nation's business is to be put on the firm dual foundation of efficient distribution as well as of economical production, if the gains made in the latter are to be conserved through corresponding frugality and sound policy in the former.

But in answer to the query directed to these distressed firms, "What are you doing about it?" 73 per cent of them reported that they were endeavoring to reduce production costs, and only 29 per cent indicated any efforts to cut sales expenses. In spite of repeated pronouncements in the trade press and by scores of research agencies and competent observers generally during recent years as to the imperative necessity of more effective, profit-yielding distribution, these facts still appear to

require repetition and emphasis if results are to be attained.

But just what should we know about distribution and how can we discover those facts? Wherein are its major wastes and exactly what is being done to remedy them? The problems which are uppermost in the minds of our distributors, according to the thousands of queries coming to the Department of Commerce each day, seem to be primarily of two varieties; (1) Where can things be sold? and (2) How much should it cost to sell them? In other words, the first confession of our shortcomings in this regard is in the field of the wastefulness of "blind" marketing, of attempting to sell in territories whose sales possibilities have not been carefully investigated. The perils of "going national" are subtle but costly for those who are not in a position to live up to the responsibilities involved in the relative cost of such widespread sales efforts.

More or less spasmodic efforts have been made during the last two decades, by some of the leading universities, trade journals and research departments of banks and larger industrials, to examine scientifically the various phases of our distributive machinery. It was not, however, until the post-war depression of 1921 that systematic and intensive campaigns for better distribution were launched. In January of that year Mr. Hoover appointed an Engineers Committee on the Elimination of Waste in Industry, whose findings touched on many phases of the problems. The joint Congressional Commission of Agricultural Inquiry, headed by Congressman Sydney Anderson, published the results of its investigation on marketing and distribution in the fall of that year. These volumes comprised a wealth of valuable data which laid the groundwork for many subsequent investigations, particularly as to the margins of profit among distributors. Previous to 1920 there had been only one or two notable works on distribution (Weld's "Marketing of Farm Products" appeared in 1915) but a wealth of literature appeared simultaneously during 1921-22, including volumes of such authorities as Nystrom, Cherington, Percival White, Ivey, Macklin, and Fred E. Clark.

Marketing Researches Listed

Today the number of agencies conducting research bearing directly or indirectly upon marketing has increased to such an extent as to necessitate a catalog of them and of their functions. With a view to eliminating duplication among them and of introducing some efficiency in this respect among these so-called efficiency organizations, the Department of Commerce is now issuing an annual list which in 1927 comprised 544 agencies. Among them are varieties of commercial or business organizations, publishers of periodicals and trade journals, trade associations, chambers of commerce, advertising agencies, research bureaus of large factories, academic institutions, foundations, universities, experiment stations and some fifty governmental agencies and bureaus (federal, state and municipal, including the Departments of Agriculture, Commerce, and Labor, the Engineers' Corps of the War Department, the Tariff Commission, and the Federal Reserve Board).

The comprehensive scope and amazing diversity of interest represented in these research groups is an encouraging indication at least of a widespread appreciation of the necessity for more intensive effort in this field, even though as yet the business community of the country lags far behind in its application of the results achieved by such research agencies. Incidentally, the Department of Commerce has undertaken to assist in the co-ordination of their work through the agency of an advisory committee representing various groups of such distribution research organizations. Through this advisory body an attempt is being made to eliminate major duplications and to insure a fairly complete coverage of the field through collaborative arrangements.

Department of Commerce Studies

The Department of Commerce has been concentrating its efforts on four or five major distribution problems, the first of which is the development of a series of regional market surveys which are intended to supply a compilation of basic data on the general commercial structure of the entire country. For the purpose of these surveys the country has been divided into nine regions based on differences in economic and business factors. The first of the series, that on the Southeastern States, has recently been completed. Similar surveys on New England, the Pacific and Southwest, and the Midwest are now in progress.

These surveys undertake to analyze what might be called the "consumer differences" in the various sections—the sources of income, influences affecting buying power, facilities for distribution, including wholesale and retail marketing arrangements, merchandising and credit trends, factors involving advertising, store and plant location, merchandising methods, commodity preference and a host of other details which might contribute toward more efficent distribution.

A special effort will be made in the New England report to cover the markets for industrial goods so as to indicate to local manufacturers as well as those outside that territory the volume and type of demand for industrial equipment.

A special study is to be undertaken in collaboration with the Retail Credit Men's Association of the costs of retail credits, with particular reference to the isolation of the factors accountable for excessive losses through unwise credit policies.

With all these various efforts under way on the part of literally hundreds of agencies, official and unofficial, academic and commercial, it would seem as though the actual materials for the improvement of this situation would be available. The next and major problem, however, is the application of the flow of data produced by these investigating agencies to the actual problems of marketing. Therein lies the great field for the future improvements of commercial conditions in the country. This is the gravest problem now confronting our business world.

Lightning Protection Areas Explained

TESTS with artificial lightning on small models in the Pittsfield, Mass., laboratory of the General Electric Company reveal that there is always a conical area of protection centered about a tall building or lightning rod, said F. W. Peek, Jr., consulting engineer of that company, in charge of high-voltage investigations, in addressing members of the American Institute of Electrical Engineers on March 22. The radius of this protected area extends from the base of the building a distance of two to four times the height of the building, depending upon the altitude of the storm cloud. The chance of another building in this protected area being struck depends upon whether or not it extends above or beyond an imaginary line drawn from the top of the taller building to the edge of the protected area.

The laboratory experiments were borne out in a natural electrical storm over New York last August, when the New York World Building was struck, Mr. Peek explained. Had this building, which is approximately 350 ft. high, been 200 ft. nearer the Woolworth Building so as to come totally within its protective cone, the flash would undoubtedly have hit the Woolworth tower or some building at a greater distance, outside the protected area.

Mr. Peek produced a diagram of the skyline of lower Manhattan, showing that the protected space about the Woolworth Building lies within a cone, the apex being at the top of the tower and the base a circle with a radius of 1,100 ft. from the bottom of the building. The New York World Building, 900 ft. from the Woolworth tower, came within this protected cone except for its dome which extended about 100 ft. above it. This, Mr. Peek said, was undoubtedly the reason the World tower was struck.

Laboratory experiments have progressed so successfully, Mr. Peek said, that the protected area plan has already been adopted in the safeguarding of oil storage tanks in southern California. Several tall rods, placed near the outside of the big oil reservoirs, provide overlapping protected areas and thus greatly reduce the hazard of conflagrations from lightning flashes.

Mr. Peek also described the cathode-ray oscillograph, an instrument which literally compels lightning to write its own autograph with a pencil of rays on a photographic film. Much can be learned from this record.

Training, Inspection and Supervision

Discussed at Welding Session

A NEWS report in last week's *Power* outlined the proceedings of the annual spring meeting of the American Welding Society, held in New York, April 25-27. Aside from the meeting of the committee on pressure vessels perhaps the most significant session from the point of view of the *Power* reader was that devoted to a preliminary progress report and discussion on the qualification of welders, inspection and supervision.

The report was presented by H. H. Moss, of the Union Carbide & Carbon Company, and discussed by A. M. Candy, of the Westinghouse Electric & Manufacturing Company; C. E. Loos, American Bridge Company; G. A. Caldwell, Mississippi Valley Structural Steel Company; E. E. Shanor, Petroleum Iron Works Company; W. C. Beakley, Whitlock Coil Pipe Company; N. E. Wagner, Prairie Pipe Line Company; A. O. Miller, Reeves Brothers; L. H. Burkhart, Struthers Wells Company, and S. W. Miller of the Union Carbide & Carbon research laboratories.

Standards, Mr. Moss stated, must be kept within the ability of the average workman; undue complication must be avoided. Design for welding is the first thing to consider. Stress transfer at the joint must be properly allowed for. The next step, he said, is to make sure that the job is properly prepared and set up and the proper welding rod employed.

The following is an outline of the remainder of Mr. Moss' report: For butt welding of materials thicker than three-sixteenths inch the edges must be beveled to get proper penetration. The dimensions of fillet welds are determined by the strength in the throat, which is the critical point.

Material for welding should be carefully selected. Common defects in the steel are dirt, slag, laminations and segregated carbon. These are easily detected by melting the edge of the metal.

Supervision is a matter of the first importance. The supervisor must make sure that the welder understands his directions and follows them. He should see that the work is carefully prepared and well set up. In piping work flexible templets should be provided if possible.

The function of inspection is to enforce the standards laid down. More and more it is becoming the practice to depend on disinterested commercial laboratories for the necessary tests. Inspectors of building departments and insurance companies will also have an increasing share in this work.

Rigorous tests for the qualification of welders will eventually help the welders themselves as well as the welding industry. When a test is first imposed on a welder, it is a training episode. Later tests tend to refine and perfect his work. Insistence upon proper qualification helps the employer by insuring good work and few comebacks.

In pipe work two standards of qualification are recommended, one for men limited to work on straight lines and the other for the higher-class welder to whom can be entrusted all jobs relating to power-plant piping, tanks, etc. The cost of qualifying the men may be an appreciable item, but it is more than balanced by other factors.

FOR SOUND WELDING

"Qualify the designer as well as the welder"—*F. T. Llewellyn.*

"Train the welder, supervise his work and test the results"—*H. H. Moss.*

"Make character an essential qualification for welding"—*G. A. Caldwell.*

"Insist on procedure control"—*S. W. Miller.*

Sometimes tacking is done by one man and the weld completed by another. In such cases each welder should have separate instructions.

As to the physical properties of welds, the test strength required must depend on the character of the work, but in practically all cases it is fair to require that the weld be as strong as the base metal.

Commenting on the paper of Mr. Moss, F. T. Llewellyn, president-elect, who presided at the meeting, said that qualification of the designer was an even more pressing need today than qualifying the welder. It is one thing to know how to make an individual weld and quite another to know how to combine welds properly in an actual structure. Mr. Llewellyn said that confusion would be avoided if standards for gas and electric welding could be kept as much alike as possible.

The welding supervisor, said C. E. Loos in a prepared discussion, should have all the abilities of a shop superintendent in knowing who can best do each job. He suggested that each workman be required to indentify his work by stamping his personal mark upon it. This would tend to eliminate failures due to qualified but careless welders. One of the best tests for a welder, said Mr. Loos, is to require him to join two pieces of different thicknesses. The weld should then be broken to study its quality.

Character is an essential qualification of any welder, declared G. A. Caldwell. The man must have a sense of responsibility. The welder should be a man who wants to weld. Here, said Mr. Caldwell, is a new skilled trade to take the place of some of the vanished trades of the past.

Speaking of training and procedure for welding large-diameter steel pipe, E. E. Shanor said that electrically welded pipe is being used more and more for hydraulic installations and water supply as well as for gas lines. The procedure in his shop, he said, is to deposit one layer of weld metal, then peen and inspect before applying the next layer. No welds made in this way have failed.

W. C. Beakley said that his company uses gas, electric and resistance welding. To qualify welders a test coupon is bent in the vise and a butt weld sent to the testing laboratory. Supervision is closely controlled. Welders are required to fuse out all tack welds.

A welded rotary lime kiln 100 ft. long was described by A. O. Miller. This has operated for four years without trouble. He showed slides of large welded pressure vessels made over a period of years. The latest designs displayed had elliptical heads with slab manholes welded in. His experience, Mr. Miller declared, gave him absolute faith in the future of welded pressure vessels.

The double-Vee weld was recommended for all work by L. H. Burkhart. He pointed out that the double Vee requires only half as much weld metal.

S. W. Miller, in concluding the discussion, stressed the importance of procedure control. He said it was a cause for congratulation that welded pressure vessels, once strongly opposed, have now gained a preferred position.

Refractories in Power Plants

By R. A. Sherman

Associate Fuel Engineer, Bureau of Mines, Pittsburgh, Pa.

This paper is abstracted from a recent issue of the Technical Bulletin, American Refractories Institute. It was originally presented at a joint meeting of that institution with the American Institute of Chemical Engineers.

ALTHOUGH the furnaces in some of the earliest steam boilers were entirely surrounded by the water in the boiler, furnaces lined with refractories have long been considered essential parts of boilers, and the manufacture of firebricks for the construction and maintenance of boiler furnaces is an important branch of the refractories industry. According to the latest figures available, 20 per cent of the fireclay refractories manufactured is used in boiler furnaces, a larger percentage than in any other one type of furnace except open-hearth steel furnaces, in which about 34 per cent of the total production is used.

Now, however, the literature of the power-plant field is replete with references to "the boiler built around the furnace," in which no refractories are used. This has apparently caused some apprehension among the manufacturers of refractories as to the future status of this important market for their product.

The purpose of this paper is to discuss: (1) The reasons for this development; (2) its significance to the refractories industry; (3) the future status of refractories in power plants.

Reasons For the Development of Water-Cooled Walls

The remarkable advances made in recent years in reducing the cost of generating steam are now well known and have resulted from three principal lines of development: (1) More efficient use of fuel; (2) use of lower grades of fuel; (3) reduction of investment costs per unit of output.

More efficient use of fuel has been made possible by improvements in the design and operation of equipment to obtain more efficient combustion and heat absorption, and reduction of investment costs has come about through the operation of boilers at higher ratings and the decrease of outage due to repairs.

Although the improvements in fuel-burning equipment, boilers and accessories have kept pace with the increased severity of service which results from more efficient combustion, higher ratings and the use of lower grades of fuel, refractories have not, and the excessive cost of repairs and outage due to their failure often limits the efficiency and rating that could otherwise be obtained.

When power engineers found that the refractories commercially available would not withstand the extreme conditions of service, they demanded improved refractories that would; and when these were not forthcoming, they adopted methods to lessen the severity of conditions without decrease in efficiency.

Air cooling was first tried, the air being used for combustion; it is successful under moderate conditions, but is limited in application because the thickness of wall between the flame and the air necessary for strength, and the low thermal conductivity of fireclay bricks result in a low rate of heat transfer.

The next development was the protection or replacement of the refractories in the most severely affected areas by water- or steam-cooled surfaces which formed part of the circulating system of the boiler. These were successful, and because the rate and efficiency of heat transfer to the water or steam are high, they have been extended to other parts of the furnace; in many furnaces refractories have been entirely eliminated.

Power engineers have been prone to place the blame for the lack of refractories that can withstand the conditions of service entirely on the ceramist and the refractories manufacturer. The justice of this accusation is questionable. The engineers should share the blame, as they should have realized that they were exceeding the safe working limit set by the inherent properties of the materials. Reversion to the water-cooled furnace is a rectification of their error.

Significance of Water-Cooled Walls

The development and installation of the water-cooled furnace has progressed with increasing rapidity during the last three years. The report of 1927 of the Subcommittee on Boilers, Superheaters and Economizers, of the Prime Movers Committee of the National Electric Light Association, shows that some type of water-cooled walls is in use or being tried by 70 per cent of the member companies that reported. They are evidently proving their worth and their use will undoubtedly continue to increase in certain fields.

However, the initial cost of water-cooled walls is generally greater than that of firebrick settings; therefore, their use is limited to those plants in which conditions of operation justify the increased investment necessary to secure high efficiencies and ratings. These conditions include high cost of fuel per ton or per unit of output of product, high load factor, and the use of fuel whose ash causes excessive slagging of refractories. Further, they can be used only with pure boiler feed water because of the danger of tube failure due to the increased rate of scale formation at the high rates of heat transfer. These conditions obtain, and the field of water-cooled walls lies, therefore, among large central heating and electric-generating stations and certain large industrial power plants.

Status of Refractories in Small Power Plants

Small public-utility or industrial power plants generally have a low load factor and therefore operate at low efficiencies because the investment in the equipment for higher efficiencies is not justified. Their refractories service conditions are not ordinarily extremely severe or, even if they are, the plant can often better afford to reduce the severity by operation at lower efficiencies than to make the investment necessary for water-cooled furnaces. There is a real demand, however, for better service from their refractories. The use of plastic refractories is increasing in these plants because of the lower cost of labor for their installation.

Between the extremes of the large and small power plants lie those plants of moderate severity of service, in many of which there may be an even choice between refractories and water-cooled furnaces. It may be taken for granted that the example set by the large plants in obtaining higher efficiencies and ratings will be followed so far as economically possible and that the refractories will be called upon to stand more severe conditions than at present.

Phelps has stated, in regard to the improvement of refractories, that a study of the base materials which offer possibilities for refractory products will show that pronounced advancement in

the development of these materials cannot be expected. However, little information is available on the minerals formed in the manufacture or in the service of a firebrick, and it is on the relative amounts of these minerals rather than the chemical composition of the raw materials that the properties of refractories depend.

The use of special refractories made from other than fireclays is deterred by their high cost.

There is probably more hope for progress in the proper application of the present product. Definite knowledge of the capabilities and limitation of refractories has been hampered in the past by the lack of definite information on the conditions encountered in service and on the mechanism involved in failure of refractories.

The adoption of water-cooled walls for furnaces in those power plants in which the conditions of service exceed the inherent limitations of refractories should benefit rather than harm the refractories industry.

Manufacturers may now devote their attention to the improvement of their product and its proper application in those furnaces in which the conditions are suited to its use; and, in order to maintain their present position in that field, it appears to their interest to support an active program of research. In order to regain business in that field where it has been lost, they might well engage in the further development of water-cooled refractory walls. Walls of refractories cooled by water tubes to prevent their rapid failure combine the desirable features of high temperatures in the furnace and efficient and rapid heat absorption in the tubes. The ultimate in the design of this type of wall at low cost has surely not been reached, and there is no reason why manufacturers of refractories should not contribute to and share in this development in power-plant engineering.

RECENT PUBLICATIONS

ARCHIV FUER WÄRMEWIRTSCHAFT UND DAMPKESSELWESEN (Archive for Heat Engineering and Steam Boiler Practice), December, 1927; monthly publication by the Verein Deutscher Ingenieure (V.D.I.), Berlin, Germany.

THIS issue is devoted to steam accumulators, their scope of application and advantages, such as increased plant production, reserve steam capacity and fuel savings. It contains a compilation of articles that describe accumulator installations in the fields of central stations, electric railway plants, and in sugar, textile, chemical and other industries. Numerous flow diagrams, tabulations of heat balance, load curves and accumulator calculations are included. One article describes how the installation of a steam accumulator made it possible to generate steam in a hydro-electric plant by surplus electrical energy during the light-load periods so as to obtain an abundance of heat throughout the day without burning fuel.

WIRTSCHAFLICHSTE ISOLIERSTÄRKE BEI WÄRME UND KÄLTESCHUTZANLAGEN UND WÄRMEABGABE ISOLIERTE ROHRE BEI UNTERBROCHENER BETRIEBSWEISE. By Dr. I. S. Cammerer. Published by Industrieverlag von Hernhaussen A.G., Berlin, for N. Krayn, book publisher, Berlin, Germany. 90 pages. Price, 6 Reichmarks ($1.50).

THIS volume treats of economic insulation thickness for both heat and cold and the effect of a discontinuous method of operation on the heat loss through insulated pipes. It contains tables and curves showing the economic thickness of insulation in mm. for different materials and conditions, and details a method of figuring the cost of insulation with relation to the heat saved. Sections are given on high-pressure steam flow and on saturated steam flow without condensate utilization, both with relation to the economic thickness of the insulation to be used. The work is based on the results of research and experimentation. It is well illustrated with charts.

PYROMETRY. By William P. Wood and James M. Cork. McGraw-Hill Book Company, Inc., New York, 1927. Cloth; 6x9 in.; 207 pages; illustrations, diagrams, tables. Price, $3.

THIS book is primarily a college text-book on the general subject of pyrometry, but it is also an excellent reference book for those who are already familiar with the use and theory of temperature measuring instruments. The material is assembled from United States Bureau of Standards publications, Glazebrook's "Dictionary of Applied Physics," as well as from the works of Burgess and LeChatelier, Henning, the several symposia on pyrometry, and from the authors' practice. It is one of the most concise treatises that has appeared on this subject.

The authors deal with the various temperature scales and the types of temperature measuring instruments, most important of which are fluid thermometers, resistance thermometers, thermoelectric (thermocouple), optical and total radiation pyrometers. The various types of temperature recorders and temperature controlling devices are clearly described.

One of the most interesting chapters is the description of the use of pyrometers in the precise heat treatment of steels and alloys.

The most valuable part of the book is found in the chapters on thermoelectric, optical and total radiation pyrometers, which are most thoroughly treated, especially from the viewpoint of industrial application and commercial testing. In discussing each type of pyrometer the treatment covers: The underlying principles of operation (possibly, in some cases, too highly technical, and mentioning too often the various early investigators); detailed descriptions of the instruments commercially available, advantages and disadvantages, as well as the limitations of the various types; range and accuracy (the data on the latter altogether too meager in some cases); installation and precautions in use; methods of calibration; tables of correction factors; and tables of data used in calibrations.

The chapters close with questions, problems and outlines for laboratory experiments.

DRANG UND ZWANG. EINE HÖHRE FESTIGKEITSLEHRE FÜR INGENIEURE. Volume II. By August and Ludwig Föppl. Published by R. Oldenbourg Company, Munich, Germany. 382 pages. Price 17.50 marks ($4.25).

THIS work on "Stress and Strain," is the second edition of the second volume of a work first published in 1920, revised and brought up to date. It is a theoretical and mathematical treatment of the performance of various structural shapes, such as cylindrical shells and plates, when stressed. Part of the work is devoted to a consideration of the hardness of materials, analyzing such testing methods as the Brinell. Engineers who design and construct high-pressure power-plant equipment will find this book useful.

WATER SUPPLY PAPER NO. 599, of the United States Geological Survey, has been published under the title, "Power Capacity and Production in the United States." The publication contains 210 pages and comprises three papers: "The Development of Horsepower Equipment in the United States," by C. R. Daugherty; "Developed and Potential Water Power in the United States and Monthly Production of Electricity by Public Utility Plants, 1919 to 1926," by A. H. Horton; and "Growth of Water Power in the United States," by R. W. Davenport. The first paper deals with power generation and utilization for the period 1840 to 1926. All three papers give the results of an exhaustive analysis of power generation, the results of which are set forth in 47 tables and 39 charts. This publication contains a wealth of statistical information for those who are interested in the growth of the power industry, the utilization of power in industries and its distribution according to industries and geographically. Copies can be obtained from the Government Printing Office, Washington, D. C.

NEWS OF THE FIELD

The editors will welcome the co-operation of readers in reporting interesting happenings, personal or otherwise

Power plant at Grand Falls will contain three 20,000-hp. units to operate under a 130-ft. head

Hydro-Electric Plant Nears Completion at Grand Falls, New Brunswick

CONSTRUCTION work is nearing completion on the hydro-electric development of Saint John River Power Company, a subsidiary of International Paper Company, on the St. John River at Grand Falls in the Province of New Brunswick. The dam and the power-house structure have been completed, the pressure tunnel has been bored and lined with concrete, and grouting is now going forward on it. The penstocks connecting the pressure tunnel with the power house are being set in place and in the power house concrete is being poured around the turbine casings.

The St. John River has its headwaters in the Province of Quebec and the State of Maine, forms part of the border between Canada and the United States, and flows through New Brunswick into the Bay of Fundy at the City of Saint John. It is about 450 miles long and is the largest river not only in New Brunswick but in the Maritime Provinces, draining the largest basin between the St. Lawrence and the Susquehanna Rivers.

Grand Falls, the site of the development and the principal water power on the St. John River, is 225 miles from the mouth of the river. At Grand Falls the river flows over a sheer drop of 75 ft. and in the chasm below, which bends around the town of Grand Falls, it has an additional descent of 50 feet.

In the initial installation there will be 60,000 hp. in three units of 20,000 hp. each. The dam is just above the falls and the pressure tunnel, 2,700 ft. in length and 24 ft. in diameter through the rock under the town, will lead the water from above the dam to the power house on the lower basin. With the added head obtained by the construction of the dam, the plant will operate under a total head of 132 feet.

Part of the power to be generated is reserved for general sale within the Province under a contract with the New Brunswick Electric Power Commission. The balance of the power available from the installation of 60,000 hp. has been sold to the Fraser Companies, Ltd., and New Brunswick International Paper Company.

The view above shows the power house and the town of Grand Falls on the plateau above.

Committees and Plans Announced for World Congress at Tokio

The program of the World Congress of Engineers to be held in Tokio next year was outlined in a cablegram received by Maurice Holland, Executive Secretary of the American Committee of the Congress, from Baron C. Shiba, vice-president of the Congress.

The meeting, Baron Shiba stated, will convene in Tokio on Oct. 30, 1929. The official languages of the Congress will be English and Japanese. The first week, the cablegram stated, would be devoted to technical papers and social meetings, the second week to inspection trips in Tokio and the vicinity and the next fortnight to trips throughout Japan especially arranged to give the delegates an opportunity to visit the great industrial and engineering centers of the country.

The World Congress, which will be attended by engineers and scientists from all parts of the world, is aimed at the promotion of international co-operation in the study of engineering science and problems. International authorities on engineering are being requested to prepare papers on subjects of interest and moment to engineers. It will be the first meeting of its kind ever held.

Eighty of the nation's foremost engineers and scientists have accepted membership on the American committees under the honorary chairmanship of Secretary Hoover and the active chairmanship of Dr. Elmer A. Sperry. The chairmanship of the individual committees as announced by Doctor Sperry follow: Finance, John W. Lieb; technical program, Dugald C. Jackson; transportation, Frank B. Jewett; entertainment, O. C. Merrill; publicity, J. H. McGraw; promotion and attendance, George W. Fuller; executive, John W. Lieb.

Wrought Iron Manufacturers Form Research Association

Representatives of the leading manufacturers of wrought iron in various parts of the country at a meeting in Pittsburgh formed the Wrought Iron Research Association, the principal object of which is to gather and disseminate information about this time-honored metal.

The members of the association are the American Swedo Iron Co., Philadelphia, Pa.; the Burden Iron Co., Troy, N. Y.; A. M. Byers Co., Pittsburgh, Pa.; Cohoes Rolling Mill Co., Cohoes, N. Y.; Ewald Iron Co., Louisville, Ky.; Glasgow Iron Co., Philadelphia, Pa.; Highland Iron & Steel Co., Chicago, Ill.; Hughes & Patterson, Philadelphia, Pa.; Logan Iron & Steel Co., Philadelphia, Pa.; Lockhart Iron & Steel Co., Pittsburgh, Pa.; Penn Iron & Steel Co., and Pittsburgh Forge & Iron Co., both of Pittsburgh, Pa.; Reading Iron Co., Reading, Pa., and Ulster Iron Works, Dover, N. J.

L. M. Johnston was elected president and Snowden Samuel, secretary and treasurer of the Association, with headquarters in Pittsburgh, Pa.

Mr. Samuel stated that the wrought-iron industry has long suffered for lack of knowledge on the part of the public about the characteristics of this material, which make it admirable for uses where a high degree of resistance to corrosion and vibration, and where high welding quality are desired.

Eight Students Receive Coffin Fellowships

Eight fellowships, awarded by the Charles A. Coffin fellowship and research committee for the year 1928-29, have been announced. Two are renewals; the others represent new applicants. These awards bring the total granted since the fellowships were established in 1922, to 47.

The eight awards for the next college year were given to the following: N. B. Reynolds, J. R. Harrison, T. S. Gray, A. F. Daniel, D. M. Tilden, R. F. Bacher, N. E. Edlefsen, L. C. Verman.

These fellowships were instituted by the Charles A. Coffin Foundation of the General Electric Company, to encourage research in electricity, physics and physical chemistry, and are given to students who, without aid, would be unable to undertake such work. Each student is permitted to choose the institution where he is to continue his research studies.

Fellowship awards were made by a committee consisting of Gano Dunn, representing the National Academy of Sciences, of which he is a former president; President Bancroft Gherardi, representing the American Institute of Electrical Engineers, and Dean Robert L. Sackett, of Pennsylvania State College, president of the Society for the Promotion of Engineering Education, representing the last-named society. Dr. W. R. Whitney, director of the Research Laboratory at Schenectady, attended the meeting of the committee as the representative of the General Electric Company.

Newcomen Society Holds Its Fourth Meeting in New York

On Thursday evening, April 26, the same day as that upon which the meeting was held at London of the parent society, the American Branch of the Newcomen Society met for the fourth time at a dinner at the Engineers' Club, New York City, Charles Penrose, of Day & Zimmermann, presiding.

There was an exchange of greetings by cable with the mother society, including felicitations by the British society to Leonor F. Loree author of the paper of the evening, on the anniversary of his seventieth birthday.

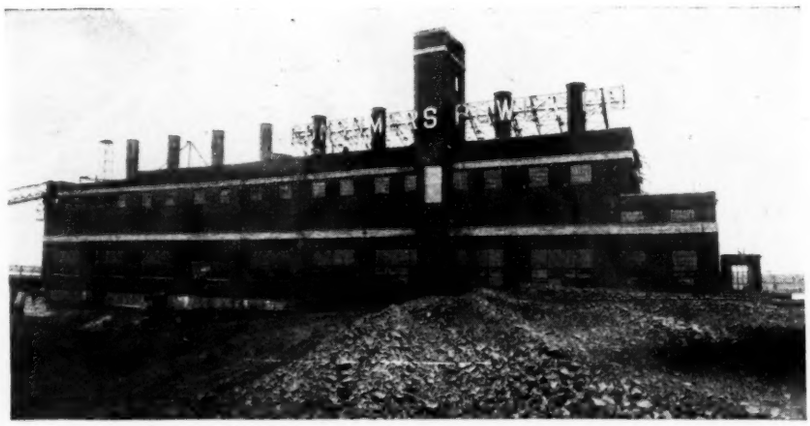
During the year Dr. William C. L. Eglin and Dr. Alexander Humphries have passed away, and appreciative reviews were made of their interest in and contribution to the work of the society.

Attention was called to the fact that the grave of Josiah Hornblower was in a practically unmarked condition in the cemetery at Belleville, N. J., and a committee consisting of L. F. Loree, C. E. Davies and F. R. Low was appointed to make arrangements for restoring the inscription on the headstone and perhaps erect a tablet indicating that Mr. Hornblower brought to this country the first steam engine ever erected on this side of the Atlantic.

F. R. Low was recommended as the American representative upon the Council of the parent society.

The paper of the evening, "Steam Boats of Lake Champlain," by L. F. Loree, president Delaware & Hudson R.R., was presented by W. J. Coughtry. After a long, interesting and formal discussion of the paper the members adjourned to visit by the invitation of Mr. Kunz, president of the Museums of the Peaceful Arts, and under the escort of Prof. Joseph W. Roe the exhibits of the museum in the neighboring Scientific American Building.

New Unit at Saginaw River Ready for Operation



Rear view of the Saginaw River steam plant of the Consumers Power Company, Mich.

ON APRIL 23 the 30,000-kw. turbine generating unit that has been installed as an addition to the Saginaw River steam plant of the Consumers Power Company was turned over for drying-out purposes, and its complement of boilers will soon be ready, so that the plant will be under full capacity by June 1.

It will be recalled that the original installation consisted of two 20,000-kw. units served by four boilers operating under steam conditions of 400 lb. pressure and 690 deg. F. Subsequently, an additional 12,300-sq.ft. B. & W. cross-drum boiler was added, and later, to provide sufficient steaming capacity for the new unit, four Walsh & Weidner boilers of the same size operating at 400 lb. steam pressure and a total steam temperature of 725 deg. F., were installed.

These boilers are equipped with combination convection and radiant superheaters, Foster-Wheeler water walls and high-pressure economizers, and Ljungstrom air preheaters which give a maximum temperature air of 350 deg. F. To be consistent, the low-pressure economizers installed with the first units have been replaced by high-pressure economizers. Each of the five new boilers is equipped with a Taylor stoker 45 tuyeres long. These are the longest stokers made by the company and in this particular installation required an overhang of 12 in. on the front wall to get them under the boilers.

In conjunction with the new work a 3,500-3,600-r.p.m., straight-condensing turbine unit has been added to the plant equipment. This unit will float on the line, operating with minimum lead in parallel with the station power transformers, which are equipped with reverse power relays to protect the house service against line troubles by cutting off the line service in the event of trouble and permitting the house turbine to pick up the load. For condenser circulating water the screenhouse and intake and discharge ducts were made of sufficient size to take care of an additional 30,000 kw. unit to be added at a later date.

It was necessary to install a new coal-handling system with capacity to handle 200 tons of coal an hour at present and capable of being speeded up to handle 350 tons per hour to care for an ultimate station capacity of about 150,000 kw. The coal-handling system consists of a track hopper and a comprehensive system of belt conveyors delivering to the overhead bunkers or to storage, with a drag scraper to assist in storing and reclaiming the coal.

Powerton Ready to Install First 55,000-kw. Unit

A ten-million-dollar bond issue of the Super Power Company of Illinois will be used in part to finance the completion of the steam-electric station at Powerton, on the Illinois River, twelve miles from Peoria. The power-house building is now ready for the installation of the first of two 55,000-kw. units. This should be ready by October this year. It is expected that the second unit will be ready for operation a year later.

The Powerton station, which is strategically situated in respect to condensing water, fuel supply and transportation, will wholesale the power produced to four large public utility companies.

World Power Fuel Conference To Be Held at London Sept. 24, 1928

The British National Committee of the World Power Conference has organized a sectional meeting on fuel problems to be held at the Imperial Institute, London, Sept. 24 to Oct. 6, 1928.

The scope of subjects to be considered at this conference is outlined in a technical program published by the British Committee. For each type of fuel, solids, liquids and gases, papers are to be presented concerning composition and classification, preparation, storage handling and transmission of fuels, and their utilization.

Many of the American engineering organizations have pledged themselves to participate in this conference and to assist in obtaining papers for presentation in London.

Second Canadian Steel and Power Show to Be Held at Toronto Sept. 4-7

Plans for the second Canadian Steel and Power Show to be held at the University of Toronto Arena, September 4-7, indicate that this event will be bigger than last year. Provision has been made for 140 exhibitors and a large increase in attendance is looked for.

A corporation has been created to conduct Canada's second Steel and Power Show without purpose of gain for its members. The Canadian section of the American Welding Society, Engineers' Mutual Benefit Fund, Canadian Engineering Standards Association, Industrial Accident Prevention Associations and Montreal Chapter of the American Society for Steel Treating will co-operate as in the previous year.

The management of the show will again be in the hands of Campbell Bradshaw, 24 Front St., West Toronto, Canada, who first conceived the idea of a Canadian show exclusively for executives, superintendents, engineers and others confronted with technical or practical engineering problems.

Coming Conventions

American Association of Engineers, annual convention, El Paso, Texas, June 4-6; M. E. McIver, secretary, 63 Adams St., Chicago.

American Boiler Manufacturers Association, annual convention, at Buckwood Inn, Shawnee-on-the-Delaware, Pa., June 11-13; A. C. Baker, secretary, 801 Rockefeller Bldg., Cleveland, Ohio.

American Institute of Electrical Engineers, annual Summer convention at Denver, Colo., June 25-29; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Institute of Refrigeration, Washington, D. C., May 10-11.

American Order of Steam Engineers, convention at Atlantic City, N. J., June 11-14, and exhibition with American Supplymen's Association. Address Fred L. Jahn, Watson of McDaniel Company, 146 N. Seventh St., Philadelphia.

American Society of Refrigerating Engineers, meeting at Detroit, June 4-7; W. H. Ross, secretary, 37 West 39th St., New York City.

American Society of Heating and Ventilating Engineers, Summer meeting at West Baden Springs Hotel, West Baden, Ind., June 26-29; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, spring meeting in Pittsburgh, Pa., May 14-17; first national oil and gas power meeting at State College, Pa., June 14-16; Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; Calvin Rice, secretary, 29 West 39th St., New York City.

American Society for Testing Materials, Atlantic City, June 25-29.

American Water Works Association. Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

Association of Iron and Steel Electrical Engineers, annual convention and Iron and Steel Exposition at Hotel Stevens, Chicago, June 25-29.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago. New England States Association convention at Hartford, Conn., June 21-23; K. W. Lundberg, secretary. Foot Guard Armory, Hartford. New Jersey State convention at the Plaza Hotel, Journal Square, Jersey City, N. J., June 2-3; T. M. Gray, State Secretary, 46 West 51st St., Bayonne, N. J.

National Board of Boiler and Pressure Vessel Inspectors, meeting at Erie, Pa., June 18-20.

National Electric Light Association, Convention and exhibition, Atlantic City, N. J., June 4-8; A. Jackson Marshall, secretary, 420 Lexington Ave., New York City.

National District Heating Association, annual meeting at Ambassador Hotel, Atlantic City, June 12-15; D. J. Gaskill, sec., 112 West 4th St., Greenville, Ohio.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Universal Craftsmen Council of Engineers, Newark, N. J., Aug. 7-10.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Output of Central Stations Increased Nine Per Cent During 1927

The output of electricity by public-utility power plants in the United States in 1927 was 80,205,000,000 kw.-hr., according to the revised figures of the Department of the Interior, just published by the Geological Survey. The increase in output from 1926 to 1927 was about 9 per cent. The amount produced by water power was 37 per cent of the total, as against 35½ per cent in 1926.

The net importation of electricity from Canada in 1927 was 1,629,000,000 kw.-hr. The total amount of electricity from public-utility sources utilized in the United States was therefore 81,834,000,000 kw.-hr. This is equivalent to 690 kw.-hr. per capita. The corresponding figure for Canada in 1927 was 1,320 kw.-hr. per capita, and that for Norway in 1925 was 2,400 kw.-hr. per capita. Norway, Canada, and the United States lead the world in the per capita consumption of electricity.

Diesel Drive Applied to Lightships

The lightships that guard the harbors and coast line of the United States, indicating reefs and submerged rocks, are the latest field for the application of Diesel-electric drive.

The Department of Commerce, Bureau of Lighthouse Service, has ordered the construction of three such vessels having an over-all length of 133 ft. 3 in. and a displacement of approximately 630 tons.

Each ship will have four generating sets, each consisting of a 120-hp. Winton Diesel engine direct-connected to a 75-kw. General Electric direct-current generator. The propellor on each boat will be driven by a 350-hp., 300-r.p.m. motor.

New Project on Bow River, Atla., to Develop 30,000 Hp.

It has been announced by the Calgary Power Company, of Calgary, Alberta, that bids will be called for shortly for the construction of a new power project on the Bow River, just below the Ghost River junction. The new project will be the largest single water-power unit yet undertaken in the Province of Alberta. It will develop from 20,000 to 30,000 hp., and will cost approximately $2,500,000. The pondage will create a reserve of 3,000,000 kw.-hr. which represents the power supply for Calgary for 15 days. This compares with present pondage at the plant at Kananaskis of 150,000 kw.-hr.

With the highest part of the concrete dam rising 95 ft. above the present river bed, the dam will give a water head of 90 ft. This is 20 ft. higher than at the company's two plants on the Bow River.

Society Affairs

Engineering Institute of Canada, Western General Professional Meeting at Vancouver, B. C., June 7-9; R. J. Gurley, secretary, Montreal, Quebec.

American Engineering Council: Spring meeting of the Administrative Board, Milwaukee, Wis., May 10-11. May 10 will be reserved for meetings of committees, while the entire day of May 11 will be devoted to sessions of the Administrative Board.

Personals

William J. Serrill, assistant general manager of the United Gas Improvement Company, of Philadelphia, has been elected to the chairmanship of the American Engineering Standards Committee. Mr. Serrill succeeds C. E. Skinner, of the Westinghouse Electric & Manufacturing Company, who has been chairman of the committee for the last three years.

L. E. L. Thomas, until recently chief engineer of the Inland Steel Company, has become associated with the Freyn Engineering Company, of Chicago, in the capacity of vice-president, associated with foreign work.

Irving E. Moultrop, chief engineer and assistant superintendent of the Construction Bureau, Edison Electric Illuminating Company of Boston, sailed on April 28 for England, for an extended business trip. On May 20 he will join Francis Hodgkinson, consulting mechanical engineer of the Westinghouse Electric & Manufacturing Company, at The Hague, where they will attend a meeting of the Advisory Committee on Steam Prime Movers of the International Electrotechnical Commission, as representatives of the United States National Committee. The Secretariat on Steam Prime Movers, of which F. R. Low is director, will be represented by its assistant director, C. B. LePage, assistant secretary of the American Society of Mechanical Engineers, who will sail for England within a week. The meeting at The Hague is to discuss the formulation of an international test code for steam turbines.

H. F. Eddy, who for years has been mechanical engineer for the Commonwealth Power Corporation, at Jackson, Mich., recently resigned his position to become associated in an engineering capacity with the Foster-Wheeler Corporation. He will be located in the company offices in New York City.

G. C. Daniels, who has been associated with the Commonwealth Power Corporation and its subsidiary companies for the last eighteen years, has been elected to succeed H. F. Eddy as mechanical engineer, with headquarters in Jackson, Mich. It will be recalled that this company does the engineering work for the Consumers Power Company, Central Illinois Light Company, Illinois Power & Light Corporation, Illinois Electric Power Company, Southern Indiana Gas & Electric Company, Ohio Edison Company, Tennessee Electric Power Company, and the Northern Ohio Power & Light Company.

Dr. John B. Whitehead, professor of electrical engineering and dean of the school of engineering of Johns Hopkins University, has been engaged as a consultant for the engineering and research staffs of the General Cable Corporation. He is to act in an advisory capacity on wire and cable insulations.

Dr. Thomas Stockham Baker, president of the Carnegie Institute of Technology, has returned from a two months' visit to Europe. During his stay in Paris he delivered a series of four lectures, in French, on "What the United States Is Thinking About," under the auspices of the Carnegie Endowment for International Peace.

J. G. Barry, vice-president of the General Electric Company, has announced the retirement of Theodore Beran, commercial vice-president of the company in charge of the New York district. Mr. Beran was elected vice-president in 1926 and had been manager of the New York district since 1903.

W. H. Fisher, president of the Power Transmission Association and vice-president of T. B. Woods Sons Company, Chambersburg, Pa., will sail May 12 for Naples, to make a study of transmission and industrial conditions in Europe. He will tour Italy, Hungary, Germany, France and England.

R. B. Sims, of Spartanburg, S. C., was elected president of the Southeastern Water & Light Association at the eighteenth annual convention held at Atlanta, Ga., April 19. Other officers elected included: H. A. Lily, Badin, N. C.; W. W. Hunter, Augusta, Ga.; J. B. Farmer, Murfreesboro, Tenn.; J. F. Pearsons, Orangeburg, S. C., vice-presidents, and S. W. Chapman, Camden, S. C., secretary.

Business Notes

E. F. Doty has resigned as assistant chief engineer of the Buffalo Steam Pump Company and has organized the E. F. Doty Pump Company, 401 Ellicott Square, Buffalo, N. Y. The new company is engaged in the manufacture of certain specialized lines of pumping machinery and is also handling sales business for the American Wells Works, Aurora, Ill., in the Buffalo territory.

The Roller Bearing Company of America, Newark, N. J., has purchased the plant of the Mercer Motor Car Company, at Trenton, N. J. The plant occupies 11½ acres and the buildings have 175,000 sq.ft. of floor space. The company will install its present equipment in the new plant and will add a large amount of new equipment.

The Foxboro Company, Foxboro, Mass., has established a branch office at 2104 Magnolia Building, Dallas, Tex. J. B. McMahon, will be the district manager.

The Ideal Commutator Dresser Company, Sycamore, Illinois, has recently appointed the Superior Supply Company, Bluefield, W. Va., as its sales representative in that territory.

Wm. W. Nugent & Company, Inc., Chicago, Ill., announces the appointment of the following western sales agencies: J. A. Deem, 5601 Alaska Ave., St. Louis, Mo.; J. G. Sarvent, 905 Locust St., Kansas City, Mo.; M. B. Urquhart, 821 17th St., Denver, Colo.;

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.35@$2.60
Kanawha.....	Columbus.....	1.25@ 1.60
Smokeless.....	Cincinnati.....	1.75@ 2.00
Smokeless.....	Chicago.....	1.65@ 2.00
S. E. Kentucky...	Chicago.....	1.35@ 1.75
Steam.....	Pittsburgh.....	1.40@ 1.80
Gas Slack.....	Pittsburgh.....	1.15@ 1.25
Big Seam.....	Birmingham....	1.40@ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.00
Birdseye.....	New York.....	1.60

FUEL OIL

New York—May 3, industrial use, tank-car lots, 28@34 deg., Baumé, 4¾c. per gal.; 36@40 deg., 5¾c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Apr. 25, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.55 per bbl.; 26@28 deg., $1.60 per bbl.; 28@30 deg., $1.65 per bbl.; 30@32 deg., $1.70 per bbl.; 32@36 deg., gas oil, 4.401c. per gal.; 38@40 deg., 4.98c. per gal.

Pittsburgh—Apr. 26, f.o.b. local refinery, 30@34 deg., fuel oil, 5¼c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—Apr. 25, 26@30 deg., $1.90@$1.97 per bbl.; 13@19 deg., $1.15 @$1.22 per bbl.; 22 plus, $1.51@$1.58 per bbl.; 27@30 deg., $2.10@$2.17 per bbl.

Cincinnati—Apr. 24, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Apr. 22, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80@85c. per bbl.; 26@30 deg., 90@95c. per bbl.; 30@32 deg., $1.05@$1.10 per bbl.

Boston—Apr. 30, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@ 32 deg., 5.65c. per gal.

Dallas—Apr. 28, f.o.b. local refinery, 26@30 deg., $1.40 per bbl.

Ford & Geirrine, 1005 Balfour Bldg., San Francisco, Calif.; Morgan Washburn, 1855 Industrial St., Los Angeles, Calif.

THE AMERICAN HOIST & DERRICK COMPANY, of St. Paul, has just appointed J. T. Seaver, Inc., Fairmount Cedar Building, Cleveland, Ohio, its representative for the Cleveland District.

THE BROWN INSTRUMENT COMPANY has secured larger quarters for its Pacific Coast Branch at 420 Westinghouse Electric Building, 420 South San Petro Street, Los Angeles, California.

HARLAN W. BIRD, merchant engineer, 1926 Conway Bldg., Chicago, has been appointed district representative by the Bayer Company, manufacturer of soot-blowing systems. As heretofore, he continues to represent the M. A. Hofft Company, builder of the National stoker and arch; also the Cork Foundation Company, maker of "Absorbo" machinery isolation.

FOOTE BROTHERS GEAR & MACHINE COMPANY, Chicago, Ill., announces that Kenneth Grant, formerly of the Machinists Supply Company of Chicago, has recently joined its sales organization and will represent the company in southern Wisconsin, northern Illinois and eastern Iowa.

TRADE CATALOGS

VARIABLE SPEED TRANSMISSION — The Reeves Pulley Company, Columbus, Ind., has just issued an attractive new catalog, No. 88, descriptive of the new design Reeves variable speed transmission. With its 64 pages the new publication is in reality a complete and detailed reference book dealing with the subject of infinite variable-speed control. It is arranged in six sections devoted to the following subjects: Construction and operating principle; composite designs, remote controls and accessory parts; automatic control; adoption of the Reeves, as standard equipment; various industries that now use the Reeves, and engineering information covering all sizes and types of Reeves variable-speed transmission.

AUTOMATIC DRAFT CONTROL — Compensated Draft is the title of a bulletin No. 164, recently issued by the Hagan Corporation, Pittsburgh, Pa., describing the Hagan system of automatic control of forced-draft stoker-fired boilers.

ALTERNATING-CURRENT SMALL-PLANT AND INDUSTRIAL SWITCHBOARDS WITH OIL CIRCUIT BREAKERS—Catalog GEA-283A has recently been issued under this title by the General Electric Company, Schenectady, N. Y. Equipment for 240 to 2,300 volts are listed, connection diagrams and space dimensions given and arrangements of applications for different plant requirements are clearly indicated.

COOLING TOWERS — The Cooling Tower Company, Inc., 5 John St., New York City, has recently issued Bulletins 273, 276, 278 and 282, in which are illustrated and described its various types of cooling towers, including the atmospheric, spray nozzle, and mechanical and chimney draft towers. Bulletin 278 is a paper by Louis A. Phillips, entitled "Cooling Water in the Modern Power Plant."

BOILER PRESERVATIVE—Garratt-Callaghan Company, Chicago, Ill., has just issued a little booklet setting forth the properties of its product, Magic boiler preservative.

INSULATED WIRE AND CABLE — A twelve-page catalog No. GEA-905, is now available from the General Electric Company, Schenectady, N. Y. This bulletin deals with the application of insulated wire and cable and includes twelve tables giving the current-carrying capacity of paper insulated lead-covered conductors installed in air and in ducts.

NEW PLANT CONSTRUCTION

Compiled by the McGraw-Hill Business News Department, which is prepared to furnish a more complete daily service to those who wish it

Ala., Tuscaloosa—E. Z. Opener Bag Co., Decatur, Ill., plans the construction of a group of buildings including 110 x 120 ft. power plant, etc. here. W. E. Spink, Pere Marquette Bldg., New Orleans, La., is architect.

Ark., Little Rock—Pulaski County, C. P. Newton, Chn, plans the construction of a jail including boiler room, etc. at Conway and Court Sts. Estimated cost $175,000. Sanders and Ginnochio, Hoad Rd., are architects.

Conn., Stamford—Owner, c/o American Greenhouse Mfg. Co., West Elizabeth Ave., Linden, N. J., Contr., awarded contract for a greenhouse and boiler room at West Ave. and Stillwater St. here. Estimated cost $40,000.

Ill., Carrollton—Hartwell Drainage & Levee Dist., awarded contract for addition to pumping station on east bank of Illinois River to E. J. Merkle, 504 Davidson Bldg., Kansas City, Mo. Estimated cost $29,462.

Ill., Chicago—W. C. Bannerman & Co., 77 West Washington St., is having sketches made for a 16 story apartment building at 7441-7443 South Shore Dr., also a 23 story office and stores building at 162-166 West Washington St. Estimated cost $2,600,000 and $2,000,000 respectively. Robert S. DeGoyler & Co., 307 North Michigan Ave., are architects.

Ill., Chicago—B. E. Bogeaus, 180 North Michigan Ave., awarded contract for a 14 story apartment building at Wrightwood Ave. and Hampden Ct. to Bogeaus Construction Co., 180 North Michigan Ave. also plans an 8 story building at 428 St. James Pl. Estimated cost $3,000,000 and $600,000 respectively.

Ill., Chicago — H. Dalsey, 64 West Randolph St., Archt., is receiving bids for the construction of a hotel including central refrigeration plant at 238 North Pine Ave. for Liberty Realty Co., c/o architect.

Ill., Chicago—S. Michin Inc., 139 North Clark St., Archt., is receiving bids for an 18 story hotel on North Dearborn St. for Powan Hotel Syndicate, c/o architect. Estimated cost $1,400,000.

Ind., Gary—County Commissioners, Lake County, will receive bids until May 14 for the construction of a court house building including steam heating system, elevators, etc. at Fourth St. and Broadway. Estimated cost $680,000. J. T. Hutton & Son, 314 Hammond Bldg., are architects.

Ind., Indianapolis—Pennsylvania and 14th Realty Co., awarded contract for the construction of a 6 story hotel at 14th and Pennsylvania Sts. to E. W. Hauser Co., 605 Merchants Bank Bldg. Estimated cost $500,000. Steam heating, ventilation and refrigeration systems, elevators, etc. will be installed.

Ia., Sidney—City awarded contract for the construction of an electric light plant to Fairbanks Morse & Co., Ninth and Harney Sts., Omaha, Neb. Estimated cost $58,460.

La., Baton Rouge—City will receive bids about June 15, for the construction of a pumping station, etc. along edge of University Lake from Menard to river for sewage treatment works. Estimated cost $180,000.

Mass., Lynn—Bender Shoe Co., M. F. Costigan, Pres., 95 State St., is having plans prepared for addition to factory and heating plant. Sanborn & Weed, Item Bldg., are architects.

Mass., Maynard — Sewerage Commission, Town Hall, is having plans prepared for the construction of a sewage disposal plant and pumping station. F. A. Barbour, Tremont Bldg., Boston, is engineer.

Mich., Pontiac—H. P. Gankler & Co., 42 Orchard Lake Ave., awarded contract for the construction of an ice plant on Paddock St. to R. S. Knapp, 15518 Idaho Ave., Detroit. Estimated cost $50,000.

Mo., Booneville—Kemper Military School, is having plans prepared for addition to power plant. Estimated cost $20,000. Henrici-Lowery Engineering Co., 402 Security Bldg., Kansas City, Mo., is engineer.

Mo., Hamilton—City voted $20,000 bonds for improvements to waterworks and distribution systems including pumping unit, etc. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, is engineer.

Mo., St. Louis—Washington University School of Medicine, 602 South Euclid Ave., is having preliminary plans prepared for a hospital including steam heating system, etc. on Campus. Estimated cost $1,000,000. Jamieson & Spearl, Arcade Bldg., are architects.

N. J., Atlantic City—Leeds & Lippincott Co., North Carolina and Beech Aves., are having plans prepared for a 6 story addition to hotel including steam heating system, etc. Estimated cost $500,000. Rankin & Kellog, 1805 Walnut St., Phliadelphia, Pa., are architects.

N. J., Bayonne—Jewish Hospital Assn., State Theatre Bldg., Jersey City, plans the construction of a 4 story hospital including steam heating system, etc. at Boulevard and 49th St. here. Estimated cost $2,000,000. Architect not selected.

N. J., Newark—Eight Hundred Fifty Broad St. Corp., c/o N. Harris, 20 Branford Pl., Archt., is having plans prepared for a 17 story office building including steam heating and ventilation systems, boilers, elevators, etc. at Broad and Lafayette Sts. Estimated cost $1,000,000.

N. Y., Albany—New York Telephone Co., 140 West St., New York, is having preliminary plans prepared for the construction of an office building here. Estimated cost $1,000,000 Voorhees, Gmelin & Walker, 101 Park Ave., are architects.

N. Y., Brooklyn—Brooklyn Union Gas Co., 176 Remsen St., had plans prepared for the construction of a gas booster station at Gardener and Maspeth Aves. Estimated cost $100,000. Bartlett Hayward Co., 200 Scott St., Baltimore, Md., is architect and engineer.

N. Y., New York—B. Beneson, 424 Madison Ave., is having preliminary plans prepared for a 25 story loft building at Third Ave. and 45th St. Estimated cost $1,750,000. Architect not selected.

N. Y., New York—Elbar Realty Corp., W. J. Baker, Pres., 76 East 52nd St., will build a 15 story apartment building at 973 Park Ave. Estimated cost $1,000,000.

J. M. Felson, 250 West 57th St., is architect Work will be done by separate contracts.

N. Y., New York—F. S. Parker, 119 West 57th St., Archt., will receive bids in June for an 11 story funeral chapel and office building at Madison Ave. and 82nd St. for F. E. Campbell, 1790 Broadway. Estimated cost $1,000,000.

N. Y., New York—Joseph Schwartz, 475 5th Ave., had plans prepared for a 16 story apartment building at 144 West 86th St. Estimated cost $800,000. J. M. Felson, 250 West 57th St., Archt.

N. Y., New York—Julius Tishman & Sons, 285 Madison Ave., is having plans prepared for one 12 and one 14 story apartment buildings at Madison Ave. and 75th St. and Park Ave. and 73rd St., also a 15 story apartment at 343 East 57th St. Estimated cost $1,350,000, $2,000,000 and $650,000 respectively. Work will be done by separate contracts.

N. Y., Poughkeepsie—Dept. of Mental Hygiene, Capitol, Albany, will soon award contract for the construction of a power plant for Hudson River State Hospital here.

N. C., Aberdeen—The Fruit Growers Express, Munsey Bldg., plans the construction of an ice and cold storage plant 50 ton capacity. Estimated cost $350,000. W. D. Martin, Washington, D. C.

O., Canton—Timken Roller Bearing Co., awarded contract for the construction of a sub-station at 1801 Harrison Ave. W. to Melborne Bros. Co., Brant Bldg. Estimated cost $62,500.

O., Cleveland — The Cleveland Electric Illuminating Co., Illuminating Bldg., awarded contract for an electric sub-station at 13100 Woodland Ave. to Hunkin-Conkey Construction Co., Hunkin-Conkey Bldg. Estimated cost $40,000.

O., Russels Point—The Orchard Island Inc., plans the construction of a hotel on Main St. Estimated cost $500,000. J. S. Adkins, 15 East 8th St., Cincinnati, is architect.

Okla., Earlsboro—A. J. Schlosser, Tulsa, plans the construction of a 20 ton ice plant here. Estimated cost $40,000. Private plans.

Okla., Eufaula — City voted $16,000 bonds for waterworks improvements including pumping equipment, etc. J. McCarson, is engineer.

Ore., Portland — J. L. DeLavlo, 2699 Beachwood Dr., Los Angeles, Calif., Archt., will receive bids about June 15, for a 10 story hotel including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc. at East 13th, E. 14th, Holliday and Mullnowah Sts., for R. B. Loyd, Los Angeles. Estimated cost $1,500,000.

Pa., Pittsburgh—U. S. Engineer Office, War Dept., awarded contract for the construction of a hydro-electric plant for Lock 6 on Allegheny River to Hopper Water Wheel Co., Springfield, O.

Pa., Pittsburgh—U. S. Engineer Office, awarded contract for the construction of a power house for Lock 6 on Allegheny River to Van Asdlen Construction Co., Stock Exchange Bldg., Philadelphia, Pa. Estimated cost $27,870.

Tenn., Cookeville — City, J. Whitson, Mayor, plans an election soon to vote $150,000 bonds for extensions and improvements to hydro-electric power plant and dam. Estimated cost $150,000.

Tex., Amarillo—Atchison, Topeka & Santa Fe Ry., 80 East Jackson Blvd., Chicago, Ill., will soon award contract for a 14 story office building including steam heating and ventilation systems, elevators, etc. at Ninth and Polk Sts. here. Estimated cost $1,000,000. E. A. Harrison, 80 East Jackson Blvd., Chicago, Ill., is architect. G. W. Harris, is chief engineer.

Tex., Brackettville — Central Power & Light Co., Frost Bldg., San Antonio, plans the construction of a 10 ton addition to ice and cold storage plant here. Estimated cost $30,000 including equipment. Private plans.

Tex., Fort Worth—Texas Building & Investment Co., is having preliminary plans prepared for a 16 story hotel including steam heating system, elevators, etc. at 1201-1205 Main St. Estimated cost $600,000. E. T. Glasgow, 915 First National Bank Bldg., is architect.

Tex., San Antonio—T. G. Cordua & Associates, c/o R. H. H. Hugman, Texas State Bank Bldg., Archt., is having preliminary plans prepared for a 16 story hotel including heating and ventilation systems, elevators, etc. Estimated cost $500,000.

W. Va., Charleston—Kanawha Valley Bank, 1 Capitol St., awarded contract for a 20 story bank and office building on Capitol St. to James Stewart & Co., 17 East 42nd St., New York, N. Y. Estimated cost $2,500,000.

Wis., Randolph—City plans an election about May 20 to vote $48,000 bonds for the construction of a new electric light plant including boilers, two new generators, switchboards, etc.

Ont., Toronto—The Robert Simpson Co. Ltd, Yonge and Queen Sts., awarded general contract for a 9 story addition to department store at Bay and Richmond Sts. to Jackson Lewis Construction Co., Federal Bldg. Estimated cost $2,000,000.

Equipment Wanted

Boiler—City of Eufaula, Okla., is in the market for a 100 hp. water tube boiler for waterworks.

Boiler, Etc.—Borough of Etna, J. Armstrong, Clk, Etna, Pa., will receive bids until May 14 for a 225 hp. horizontal water tube boiler and appurtenances.

Boiler, Pumps, Engines, Etc.—Mayor and Bd. of Alderman, Leland, Miss., will receive bids until May 22 for one 200 hp. water tube boiler, two 750 g.p.m. motor driven centrifugal pumps, one 150 and one 250 kw. Diesel engines or one 300 kw. unaflow steam engine, etc. for improvements to power plant.

Boilers, Pumps, Etc.—Owner, c/o G. L. Rosebrook, 1404 Franklin St., Oakland, Calif., Archt., plans to purchase high pressure steam boilers, pumps, etc. for proposed auto laundry. Estimated to cost $18,000.

Engines and Accessories—Quartermaster General, Washington, D. C., will receive bids until May 18 for the installation of three 750 hp. Diesel engines and accessories at Ft. Mills, P. I.

Engines, Pumps, Etc.—City of Santa Cruz, Calif., plans to purchase Diesel engines, pumps and necessary auxiliary equipment for proposed pumping plant.

Generator — Kemper Military School, Booneville, Mo., plans to purchase an engine generator for proposed addition to power plant.

Generating Unit, Condensers, Switchboards, Etc.—City of Kendallville, Ind., will receive bids until May 22 for furnishing delivering and erecting one 1,000 kw. steam turbine driven generating unit, condenser for 1000 kw. turbine, surface condenser and auxiliary equipment, electrically operated and manually operated switchboards, etc.

Ice Plant Equipment—A. J. Schlosser, Tulsa, Okla., plans to purchase equipment for proposed ice plant at Earlsboro, Okla.

Motor—P. O. Box 324, Chelmsford, Mass., is in the market for a 100 hp., 600 v. a.c. motor.

Motors, Etc.—A. L. Flint, Genl. Purch. Officer of the Panama Canal, Washington, D. C., will receive bids until May 14 for motors, etc.

Motors—Texas Airplane Corp., Route 1, Box 101, San Antonio, Tex., wants prices and catalogs on all types of airplane motors, also equipment and motors for shop work.

Power Plant Equipment — Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until June 6 for power plant equipment including two 250 kw. Diesel engine generator sets motor generator sets, motor driven centrifugal fire, fresh water and oil pumps, water softening equipment, a.c. motors for existing air compressors, ammonia compressors and evaporator pumps, switchboard, etc., at Naval Station, Guantanamo Bay, Cuba.

Pump — Quartermaster Corps., Ft. Sam Houston, Tex., will receive bids until May 15 for one motor driven centrifugal pump with motor.

Pumps, Etc.—Dept. of Public Works, Bureau of Water, City County Bldg., Pittsburgh, Pa., will receive bids until May 10 for furnishing and erecting boiler feed and hot well pumps and appurtenances for Ross pumping station.

Pumps and Motors — J. L. Lehman, Recorder, Romney, W. Va., will receive bids until May 17 for pumps and motors for proposed waterworks improvements.

Turbine and Generator—Canadian Paperboard Co., 32 Front St. W., Toronto, Ont., plans the installation of a 1,500 kw. steam turbine and generator in connection with plant now under construction. Estimated cost $50,000.

Industrial Projects

Calif., Live Oak—PACKING PLANT—Sacramento Valley Walnut Growers' Assn., N. F. Todd, Pres., plans the construction of a packing plant. Estimated cost $40,000.

Calif., Santa Clara—PACKING PLANT—Rosenberg Bros., 334 California St., San Francisco, awarded contract for a 3 story plant to Lindgren-Swinerton Inc., 225 Bush St., San Francisco. Estimated cost $50,000.

Conn., Hartford—DAIRY—R. G. Miller & Sons Inc., 151 Earl St., awarded contract for a 2 story, 66 x 66 ft. dairy to Wise & Upson, 7 Forest St. Estimated cost $50,000.

Mich., Grand Rapids — BAKERY — Kroeger Grocery & Baking Co., Cincinnati, O., will receive bids until May 10, for a 3 story, 100 x 220 ft. bakery including loading shed, etc. on Buchanan St., here. N. Tebow, 540 Main St., Cincinnati, O., is architect. B. Tuttle, Birkeley Bldg., Cleveland, O., is construction architect.

Mich., Lansing—MOTOR CAR FACTORY—Durant Motors Inc., Flint, awarded contract for a 1 and 2 story addition to factory here, to H. G. Christman Co., Porter Apartments, Lansing. Estimated cost $750,000.

Mich., Monroe — AUTO ACCESSORY FACTORY — Monroe Auto Equipment Co., East First St., awarded contract for a 1 story, 55 x 180 ft. factory for the manufacture of auto shock absorbers to Gettins & Kopitke Co., 15th St., Toledo, O. Estimated cost $50,000.

Mo., St. Joseph—CEREAL MANUFACTURING PLANT—Quaker Oats Co., 80 East Jackson Blvd., Chicago, Ill., awarded contract for a cereal manufacturing plant here to Leonard Construction Co., 37 South Wabash St., Chicago, Ill. Estimated cost $3,000,000.

N. J., Irvington—CHAIN FACTORY ADDITION—Forstner Chain Corp., 646 Nye Ave., awarded contract for a 3 story, 60 x 120 and 30 x 80 ft. addition to chain factory at 642-644 Nye Ave., to W. J. MacEvoy Construction Co., 85 Academy St., Newark. Estimated cost $60,000.

N. J., Passaic—PAPER BOX FACTORY—Victory Paper Box Co., 753 Main St., is having plans prepared for a 1 story, 118 x 142 ft. factory at 70-78 Liberty St. Estimated cost $55,000. Preiskel & Skvarla, 2 Lexington Ave., are architects.

O., Minerva—SWITCH PLANT—American Electric Switch Corp., plans a 2 story addition to plant for switchboard, panelboard, knife switch and shipping departments.

O., Cleveland — BOOKBINDING FACTORY—The Commercial Bookbinding Co., A. Cahn, Pres., 2251 West 110th St., awarded contract for a 1 story, 106 x 120 ft. addition to factory to W. Dunbar Co., 8201 Cedar Ave. Estimated cost $45,000.

Pa., Pittsburgh—SAFETY APPLIANCE FACTORY—Mine Safety Appliance Co., Braddock Ave., awarded contract for two 1 story factory buildings one at Braddock Ave. and one at Meade St. to Taylor Meyer Co., Keystone Bldg. Estimated cost $90,000.

S. C., Spartanburg—LOOM PLANT—Standard Looms Inc., J. Andrews, Pres., 519 East Main St., is having preliminary plans prepared for a plant including assembling plant, foundry, machine shops, etc. Estimated cost $200,000. Lockwood Greene & Co., Piedmont Bldg., are architects and engineers.

S. C., Spartanburg—YARN FACTORY—The Yarns Corp. of America, 40 West 20th St., New York, N. Y., awarded contract for a 1 story, 106 x 219 ft. factory here to Fiske-Carter Construction Co., Spartanburg. Estimated cost $250,000.

Tenn., Nashville—SHOE PLANT—Jarman Shoe Co., 207 Shelby Ave., awarded contract for the construction of a plant to Foster-Creighton Construction Co., Fourth and First National Bank Bldg. Estimated cost $150,000.

Tex., Port Arthur—REFINERY—Stillwell Benzol Refinery Co., A. E. Stillwell, plans the construction of a refinery, 1,000 bbl. capacity. Estimated cost $350,000.

Tex., Sweetwater—REFINERY—Bell Oil & Gas Co., is having preliminary plans prepared for the construction of a gas and oil refinery. Estimated cost $100,000. Private plans.

Vt., Pownal—CEMENT PLANT—Portland Cement Corp., L. L. Griffiths, Pres. Ann Arbor, Mich., plans the construction of a cement plant here. Estimated cost $1,000,000.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

ELECTRICAL supplies hold steadily to April price levels on items covered in the accompanying list. Minor price fluctuations occurred in several of the power-plant supplies. A new quantity price base is declared on steel structurals at warehouses. White and red lead dropped ½c. per lb.; rivets re-acted after price gains in April; babbitt metal, intermediate grade, rose 6c. per lb. during the month.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 68c. per ft.
Common, 2½-in., cotton, rubber-lined	80c. per ft. list, less	50%

Air—Best grade

	3-ply	4 ply
¾-in., per ft.	$0.36½	$0.44

Steam—Discounts from List

First grade....30-10% Second grade....40% Third grade....45%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade.... 45% Second grade.... 50%

LEATHER BELTING—List price, 24c., per lin.ft. per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	35%
Heavy	30%

RAWHIDE LACING—For cut, best grade, 30-10%; 2nd grade, 50-10%. For laces in sides, best, 46c. per sq.ft.; 2nd, 42c. Semi-tanned, cut, 30-10%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Asbestos for high-pressure steam, ⅛ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.55
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ¼- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25@$2.35 per bbl. without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.30 per 100 lb. in lots of 250 to 3,999 lb. Lots of 249 lb. and under carry an extra charge of 50c. net per order.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00
Colored	9.00@13.00	12.00	12.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.15
New York	.15@.17½
Cleveland (*per thousand*)	38.00

LINSEED OIL—These prices are per 7½-lb. gallon:

	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.76½	$0.84	$0.78

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry	In Oil
Red	$13.25	$14.75
White	13.25	13.25

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Tank rivets, small, including ⅞-in. dia., list (Apr. 1, 1927) less 50-10% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ¾-in., per 100 lb.:
New York..... $5.00* Chicago... $3.60† Pittsburgh mill.....$2.90

Cone-head boiler rivets., ¾-in., per 100 lb.:
New York..... $5.00* Chicago... $3.60† Pittsburgh mill.....$2.90

*Price is for full packages; broken package lots, $6.50 net, delivered. †f. o. b.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50% Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50% Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa.	per M	43.00
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	70.00
Commercial genuine, intermediate grade	63.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.00

COLD DRAWN STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.40	$3.65	$3.60
Flat or square	3.90	4.15	4.10

BOILER FITTINGS—F. o. b. New York or Jersey City, discounts from list:

	Current
Copper ferrules	70%
Boiler flanges	65-5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts are for carloads at Pittsburgh mill:

BUTT WELD

	Steel Black	Steel Galv.		Iron Black	Iron Galv.
Inches			Inches		
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	47½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouses on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17 07
1¼	.....	.....	19 20
1½	.....	$38 00	17 92
1¾	.....	28 50	20 48
2	$17 33	25 00	20 24
2¼	19 84	28 25	23 00
2½	21 60	34 00	26 03
3	25.50	42 50	27 04
3½	30.25	49 50	30 67
3½	31.50	52 75	33 33
4	38.03	67.00	40.11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.

These prices are net, per 100 ft., based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller.. 5c. per cut. 3 in..... 9c. per cut.
2¼ and 2½ in..... 6c. per cut. 3½ to 4 in.... 10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid.....	$29.00 (net)	$44.00 (net)	$180.00	$220.00
No. 12 solid.....	136.00	180.00	225.00	275.00
No. 10 solid.....	185.00	235.00	275.00	325.00
No. 8 stranded...	305.00	375.00	420.00	500.00
No. 6 stranded...	440.00	530.00	615.00	.....

From the above lists discounts are:		Lead Covered
Less than coil lots.....	50%	30%
Coils to 1,000 ft.....	60%	35%
1,000 to 5,000 ft.....	65%	38%
5,000 ft. and over.....	67%	40%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, per 100 pieces, extra f.o.b. New York warehouse. Discount of 5 per cent. for payment in 10 days. Delivery charges, approximately 4 per cent. additional.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
¾	72.07	78.63	10.21	11.63	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224.85	245.94	50.13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508.50	218.74	246.10	41.59	45.01
3½	585.30	637.74	483.04	543.46	55.46	60.02
4	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package.....	10%	20%	28%
Less than standard package.....	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.....	$0.12	D. P. D. B.....	$0.31
D. P. M. L.....	.16	T. P. S. B.....	.35
T. P. M. L.....	.27	T. P. D. B.....	.47
D. P. S. B.....	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.....	$0.27	$0.70	$1.75
T. P. M. L.....	.40	1.00	2.30
D. P. S. B.....	.35	.87	.....
T. P. S. B.....	.67	1.50	.....
D. P. D. B.....	.65	1.75	.....
T. P. D. B.....	1.12	3.00	.....
T. P. to D. P. D. B.....	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy.....		$17.20
No. 16 cotton reinforced heavy.....		21.00
No. 18 cotton reinforced light.....		13 20
No. 16 cotton reinforced light.....		17 60
No. 18 cotton Canvasite cord.....		14 60
No. 16 cotton Canvasite cord.....		16 90
No. 16 super service cord or similar (2 wire) in 1,000 ft....	$72.00	*80.00
No. 14 super service cord or similar (2 wire) in 1,000 ft....	110.00	*122 00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100 amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 64%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.....	$0.50	$1.10	100	10
35 to 60-amp.....	1.00	1.25	100	10
65 to 100-amp.....	2.00	3.00	50	5
110 to 200-amp.....	4.00	5.00	25	5
225 to 400-amp.....	7.50	11.00	25	1
450 to 600-amp.....	11.00	16.00	10	1

REFILLS—

1 to 30-amp.....	$0.03 ea.	$0.05	100	100
35 to 60-amp.....	.05 ea.	.06	100	100
65 to 100-amp.....	.10 ea.	.10	50	50
110 to 200-amp.....	.15 ea.	.15	25	50
225 to 400-amp.....	.30 ea.	.30	25	25
450 to 600-amp.....	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton.....	5%
Unbroken carton but less than standard package....	22%
Standard package.....	40%
Discount Without Contract—Renewals:	
Less than standard package.....	Net list
Standard package.....	40%
Discount With Contract—Fuses:	
Broken cartons.....	10%
Unbroken cartons but less than standard package...	26%
Standard package.....	42%
Discount With Contract—Renewals:	
Less than standard package.....	Net list
Standard package.....	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500).....	$2.50
0-30 ampere, less than standard package.....	2.80

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.23	25	A 19	$0.28
25	A 19	.23	50	A 21	.28
40	A 21	.23	100	A 23	.50
50	A 21	.25	....	....	....
60	A 21	.25	....	....	....
100	A 23	.40	....	....	....

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug.....	$0.18
Composition, 2-piece, attachment plug.....	.27
Swivel attachment plug.....	.12
Small size, 2-piece plug, composition.....	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14.....	$5.75	$9.10	$10.69	$17.00
12.....	9.20	12.20	13.80	23.25
10.....	12.85	15.80	17.90	30.15
8.....	18.75	21.65	23.20	41.40
6.....	.....	.....	33.00	.....
4.....	.....	.....	46.30	.....
2.....	.....	.....	64.00	.....
1.....	.....	.....	89.35	.....
0.....	.....	.....	110.00	.....
00.....	.....	.....	129.00	.....
000.....	.....	.....	157.00	.....
0000.....	.....	.....	185.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	½ In. or Pendant Cap Keyless	½ In. or Pendant Cap Pull	¾ In. Cap Key	¾ In. Cap Keyless	¾ In. Cap Pull
Standard package.	$0.11	$0.11	$0.18	$0.16½	$0.15	$0.22
Unbroken carton..	.14	.13	.20	.18	.16	.23
Broken carton....	.16	.15	.22	.20	.18	.25

WIRING SUPPLIES—

Friction tape, ¾ in., less than 100 lb., 31c. per lb.	100 lb. lots....	29c. per lb.
Rubber tape, ¾ in., less than 100 lb., 33c. per lb..	100 lb. lots....	31c. per lb.
Wire solder, less than 100 lb., 33c. per lb.....	100 lb. lots.....	31c. per lb.
Soldering paste, 2 oz. cans.....		$1.00 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:

Less than $25.00 list value.....	30%
$25.00 to $50.00 list value.....	30-5%
$50.00 list value or over.....	35%